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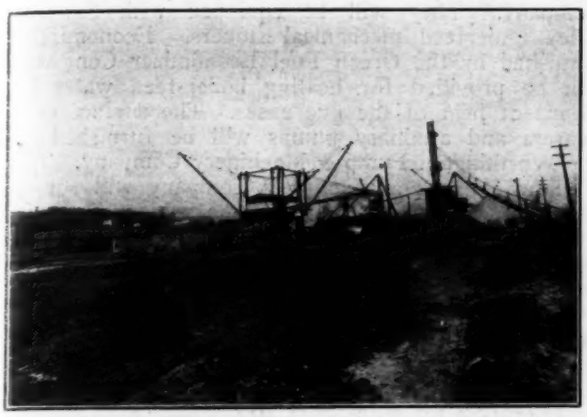


General View of the Site and Construction Work on Foundations.

View Looking Northeast Across Condenser Well.

New Station of Kansas City Light & Power Company

Work Being Pushed on Large and Efficient Plant to Overcome Power Shortage—Ultimate Capacity to Be 150,000 Kilowatts, of Which 50,000 Are Being Installed in Two Units

THE Kansas City Light & Power Company is erecting on the banks of the Missouri River, within a mile and a half of the business district of Kansas City, Mo., a central station designed for an ultimate capacity of 150,000 kilowatts. Fifty thousand kilowatts of this capacity will be available by the first of November, 1918, and Kansas City will therefore have an adequate supply of electricity for light, power, and street railways next winter—a very gratifying prospect for the citizens and the business interests in view of the power shortage of the past few months.

During the recent winter, the power plant of the Kansas City Railways Company combined with the very small capacity of the light company provided for a peak load of only 57,000 kilowatts and several thousand kilowatts of possible business could not be supplied. Only by the most generous co-operation from the users of electricity could the energy be distributed where the utmost need prevailed.

The new plant, which is called Northeast Station, is being erected at the foot of Brooklyn Avenue on 25 acres of ground that were slightly below the flood level marks a few years ago. The contract for the purchase of the ground provided that the seller should build revetments along 1700 feet of river front and embankments along the east edge of the property so that back water from the highest floods could not get on the land. These banks are now at a level above that of the greatest flood ever experienced on the Missouri River, that of 1844. Whether floods come this spring or not, the property is safe. Several switch tracks are now being used and more being laid on the property. These are also on a level above that of the greatest flood.

The total expenditure arranged for by the light company in connection with this new plant is $15,000,000. Of this sum, $5,220,000 is to be expended before the close of 1918, included in which is the $250,000 for real estate.

An item of economy is the fact that the new station is only one mile from the big plant of the Kansas City Railways Company and the main feeders will run from the new plant to the Kansas City Light & Power Company's substation near the railways company's plant for distribution from there to the city. Frequency changers at this substation will permit tying in the railways company's 25-cycle system with the power company's 60-cycle system. Two additional substations will be added to the latter system.

The contract for the foundation and the superstructure was let to The Foundation Company of America. This company is now well advanced on the work. The foundations are going down 50 to 60 feet to a firm gravel base. The condenser well is practically complete. It is 70 feet in diameter, inside measurement, with concrete walls 6 feet thick at the top and the bottom having a thickness of 18 feet. Two

intake wells are being erected now, each of the same dimensions as the condenser well. Only one of these wells will be used with the present installation. Traveling screens are to be installed in the intake wells; the screen contract has not yet been let. One intake tunnel is now being constructed, 10 feet wide, 20.5 feet high, with walls 2 feet thick and to extend 40 feet into the river. One of the illustrations herewith shows the crib for the intake about to be launched. A discharge tunnel is being built to take care of the ultimate capacity of the plant. It is 12 feet wide, 15.5 feet high, with walls two feet thick. Two hundred thousand gallons of water can be handled a minute through one intake tunnel and intake well. The discharge tunnel will handle double this capacity; its mouth is 1000 yards on the river below the intake.

Some Equipment Details.

The contract for the main turbines and electrical equipment has been let to the General Electric Company. Two 25,000-kilowatt turbines, multistage machines, will be installed this year over the condenser well. The two machines were recently on the test floor of the General Electric works being tested. Provision is being made now for the later installation of another 25,000-kilowatt machine in connection with these two over the condenser well, when, as expected, the business demands it. The main generators are 13,200-volt, 60-cycle, three-phase machines.

The plant is designed to burn coal, storage for which is in a pit with a capacity of 50,000 tons where the coal will be submerged under water. The Link-Belt Company has the contract for bucket conveyors, overlapping type, to transfer the coal from the pit to the bunkers. The Whiting Foundry Equipment

View Looking East Across Intake Crib.

Company will supply the coal and ash-handling cranes and the large electric crane for the turbine room.

The experience of the last two or three years has shown the necessity of providing for the use of lump coal. There have been many times when companies using coal under boilers could not get screenings and had to buy any kind of coal they could get. The Kansas City Light & Power Company is providing, therefore, for traveling motor-driven coal crushers supplied by the Orton & Steinbrenner Company; into these the coal will be dumped from the cars and reduced to size suitable for the stokers.

The situation of the new plant on the banks of the river where the ground is low simplifies the disposition of ashes. The company will have its own cars which will be run on tracks provided for the purpose in aisles between the rows of boilers and into these cars the ashes will be dumped from the hoppers in which they are automatically received from the boilers. There is much ground on the company's property to fill and neighboring property owners will also be saved the heavier expense of pumping sand onto their ground when they can get ashes from the power company.

The boilers in the plant will be of the latest type of water-tube boilers made by the Babcock & Wilcox Company. They will be equipped with Sanford Riley underfeed mechanical stokers. Economizers, furnished by the Green Fuel Economizer Company, will be provided for heating boiler-feed water by means of heat of the flue gases. The surface condensers and auxiliary pumps will be furnished by the Worthington Pump & Machinery Company. The Ludlow Valve Manufacturing Company will supply four 48-inch flanged hydraulic gate valves.

Six boilers are to be installed this year. Each will have 13,512 square feet of heating surface, exclusive of the superheaters. The boilers are designed for a gauge pressure of 300 pounds per square inch. Each is rated to evaporate from 70,000 to 120,000 pounds of water per hour from a feed-water temperature of 220 degrees Fahrenheit. Each boiler will have a separate economizer with about 4000 square feet heating surface and two Green induced-draft fans on one shaft direct connected to a 120-horsepower motor.

Each main unit will have a Worthington surface condenser with 35,000 square feet cooling surface. Auxiliary to each condenser will be a 36-inch vertical circulating pump; two 5-inch, horizontal, two-stage, hot-well pumps; three No. 10 hydraulic vacuum pumps; these auxiliaries will be motor-driven. The Worthington company will also furnish four 4-inch horizontal boiler-feed pumps, each of 600 gallons per minute capacity and driven by a 150-horsepower General Electric noncondensing steam turbine. Also four 10-inch horizontal volute supply pumps and two 4-inch sand pumps.

Every detail of the big plant has been designed to secure the highest practical economy of operation and the greatest reliability of service. Sargent & Lundy, of Chicago, are the designing engineers of the plant and are supervising its construction.

The announcement by President J. F. Porter, of the light company, of plans for the erection of the new central station and the actual beginning of work has done much to alleviate the depression in the minds of business men of Kansas City. For three or four years there has been comparatively little effort to add power consumers and for many months larger power users have had to restrict their operations because of the shortage of power. The Kansas City Light & Power Company has actually refused business which would have increased its load 13,000 kilowatts, because the power could not be supplied. Nobody can estimate the amount of business that is already waiting for the completion of the new plant, but a good guess would be ten to fifteen thousand kilowatts. Many manufacturers who should have electric power in their factories have never given the matter more than a casual thought. Domestic consumers have also been handicapped in the past year because of the occasional failure of the supply due to the demand of the street-car service at times when the plants were partly out of commission. No consistent and sustained drive for their business has been made for several years.

Studies in Wood, Steel and Concrete Pole-Line Costs

Conclusion of Comparative Cost Studies of Poles for Electric Lines—Steel Poles and Concrete Poles—General Summary

By F. L. HAUSHALTER

[The first and second parts of this article appeared in the ELECTRICAL REVIEW *of April 6 and 13, 1918. In the first part were discussed the fundamental considerations on which the calculation of the comparative annual charges of wood poles was based by the author. The second part continued this discussion as regards the comparison of charges for untreated and treated poles. The third and last part, which appears below, discusses the costs of several types of steel and concrete poles, and gives the author's summary of the comparative advantages of different pole materials.]*

There are several different types of steel poles that might be considered, but the three types considered in this article are: frame triangulate poles made up of angle irons; "A" poles of angle irons referred to in this article as "A-Flex" poles, as made by the Franklin Steel Works; and tubular poles that are made up in sections of different diameters and these sections joined together by collars.

Steel poles first came into use in electric railway work and for lighting standards. The use of steel and concrete poles does not seem to progress very rapidly. The attitude of public utilities is a discouraging factor in the use of such poles. A line of such poles put in by a company would be a permanent one, but the idea of permanency is the one that companies shun. The doubtful practice of municipalities in giving franchises, the action of state legislatures in giving municipalities the right to compete with companies that had thought they had exclusive franchises, the danger of unfair regulation of rates at an early date, all these combined with the prospects of alterations for future capacity of the lines give seemingly just causes for the slow action of public utilities in erecting steel and concrete poles, since it is not known whether or not the increased amount of money put into an initial outlay will be favorable to the best interests of the companies. As the policy of regulating bodies becomes established and public opinion has become more favorable, these companies will know better how to plan for the future and lines will be built with the idea of permanency more than they are now.

The price of steel quoted by the Franklin Steel Company, the manufacturer of the triangulate and "A-Flex" poles, considered herein as normal is 2.5 cents per pound. The triangulate poles of the No. 10 section here considered are made up of $2\frac{1}{2} \times 2\frac{1}{2} \times 3/16$-inch angle irons latticed together by $2 \times 3/16$-inch flats. The legs are specially rolled 60-degree angles. The poles are about 8 inches on the side at the top and taper approximately one-half inch per foot. A 50-foot No. 10-section pole is designed to withstand a side pull of 1000 pounds applied 18 inches from the top with a factor of safety of two. These poles are therefore very able to stand the loads as figured for the wood poles, the greatest being 600 pounds for a 100-foot span. As in the wood-pole line the cost of freight and labor are figured, the freight being figured from Pittsburgh, Pa., in car-load lots.

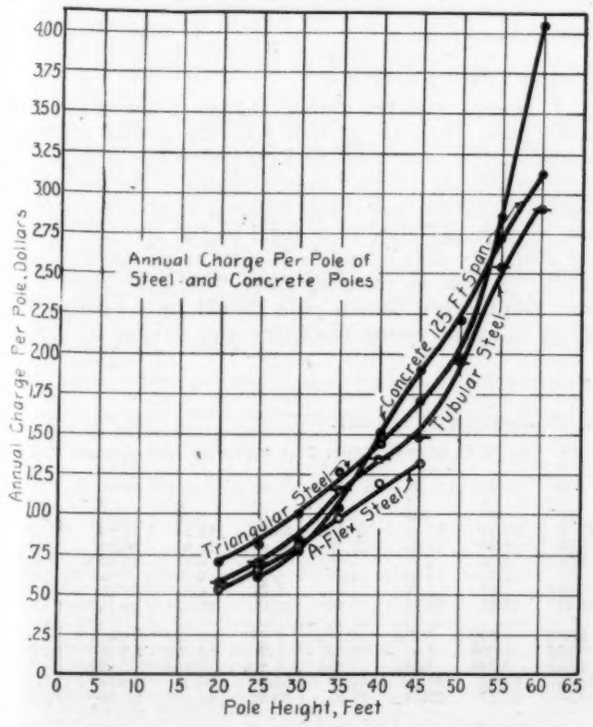


Fig. 6.—Annual Charges per Pole of Steel and Concrete Poles.

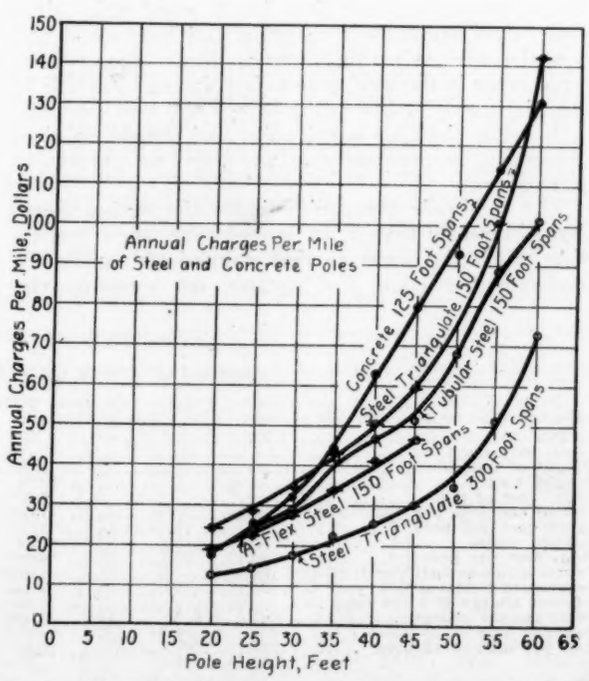

Annual Charges Per Mile of Steel and Concrete Poles
Annual Charges Per Mile, Dollars
Pole Height, Feet
Concrete 125 Foot Spans
Steel Triangulate 150 Foot Spans
Tubular Steel 150 Foot Spans
A-Flex Steel 150 Foot Spans
Steel Triangulate 300 Foot Spans

Fig. 7.—Annual Charges per Mile for Steel and Concrete Poles.

The cost per cubic yard of concrete foundation is taken as a normal one at $6.00. It is believed that this will include the necessary items of expense in building the foundation and obtaining the materials in places where ordinary conditions as regards sand, gravel, water and cement are prevalent. Square concrete foundations are figured; triangular ones would be just as serviceable and a little cheaper, but square ones are usually used. One item that enters in figuring costs for steel poles that does not enter into wood or concrete-pole calculations is that of salvage. When the steel pole is removed it can be sold for junk and this junk value is taken as 60 cents per 100 pounds as a normal figure that allows for cartage to the place of disposal. Salvage is subtracted from pole costs.

In case of steel and concrete poles the pole life is taken at 30 years. The life of good steel and concrete poles, if properly built, is indefinite provided the steel is painted and maintained intact from the weather attacks. However, the uncertainty of the permanence of the line in the light of a possible change of the line leads to the adoption of 30 years as the pole life. Hence the depreciation charges are based on this figure.

From the tabulated results it is seen that the steel poles in heights from 30 to 60 feet cost less in annual charges than the western cedar poles. In case of the 35-foot pole, for instance, the steel charge is $1.263 per year, while the western cedar pole is $2.022 per year or a saving of 26.7 per cent over the wood pole. It may be thought that the labor costs given in the steel-pole calculations are too low, but it will be noticed that these steel poles weigh even less than the wood poles, the 60-foot steel pole weighing but 1120 pounds, whereas a 60-foot cedar weighs about 1650 pounds. Although the steel pole may be more inconvenient to handle, yet its reduced weight compensates for this inconvenience.

The cost per mile is figured with two different spans, that for 35 poles per mile or a 150-foot span and that for 18 poles per mile or a 300-foot span. The poles are built for these spans for it should be borne in mind that the factor of safety for a steel pole needs only be about one-half that for a wood pole, since wood offers uncertainty in grain and heartwood and circumference reduction through decay, factors that do not enter in the steel-pole safety factor. As will be seen, the use of these spans brings the cost per mile much below that for wood poles and should be plain inducement to companies to use them on permanent rights of way.

The steel-pole companies figure the saving somewhat differently than it is figured here, their method being much the same as that pointed out under the wood-pole discussion. For instance, one company tries to show the saving of steel poles as an investment over wood poles by the following calculations:

WOOD-POLE LINE—COST OF ONE MILE.

52 30-foot poles at $3.50 per pole	$182.00
52 holes to dig at $1 each	52.00
52 poles to set at $1 each	52.00
52 poles to distribute at $1 each	52.00
Miscellaneous expenses, such as cutting gains, trimming, etc.	50.00
Total cost per mile	$388.00

STEEL-POLE LINE—COST OF ONE MILE.

17 poles required at $13.50 each	$229.50
17 holes to dig at $1 each	17.00
17 poles to set at $1 each	17.00
17 poles to distribute at $1 each	17.00
17 concrete foundations at $2 each	34.00
Miscellaneous costs	25.00
Total cost per mile	$339.50

These latter figures consider the steel poles spaced at 300 feet apart. If however, they are spaced at but 150 feet apart, the cost per mile is $679.00.

This method estimates concrete and labor costs roughly and does not consider the investment from the viewpoint of annual charges in which depreciation and interest play an important part. By referring to the figures for annual charges per mile it is seen that even in using 150-foot spans for the 35-foot pole the annual cost per mile for the steel is but $44.30 as compared to $70.80 for the western cedar. This difference seems large, but it is believed that everything has been figured on the basis of equity.

The "A-Flex" pole as put out by the same company offers even more contrast. This is a two-legged pole, or "A" frame, designed especially for telephone lines and for light power lines. As put out by the company it has webs on the bottom that permit its being buried in the ground substantially without using concrete foundations. In these calculations, however, concrete foundations have been figured so as to place the pole in the class of permanent line construction and make it decidedly safe. The costs have been figured in the same manner as for the triangulate poles. Of course, the concrete costs run less since not so large a foundation is required for an "A" pole as for a triangulate one. These poles are designed to stand a side strain of 2500 pounds with a factor of safety of two. However, it is best not to use them in heights above 50 feet on account of their flexibility.

It is seen that the annual charges come below the triangulate. For the 35-foot pole the annual charges are $0.973 as compared to $1.263 for the triangulate pole and $2.022 for the western cedar. The company claims that these poles may be used at 150-foot spans, but even though they were used on the 100-foot spans the costs per mile would be low as compared to wood poles. Of course, in using these "A-Flex" poles in a line about every fourth pole should be a triangulate so as to avoid undue flexibility and danger of a line

TABLE IX.—COSTS OF STEEL TRIANGULATE POLES.

Price of steel 2.5 cents per pound. Freight rate from Pittsburgh, Pa., to Columbus, Ohio, 12.6 cents per 100 pounds. Junk value taken as 60 cents per 100 pounds. Life taken as 30 years.

Length over all, ft.	20	25	30	35	40	45	50	55	60
Depth in ground, ft.	3	3	3	4	4	5	5	6	6
Weight of pole, lbs.	270	330	396	463	533	602	673	1,000	1,120
Freight cost	$0.34	$0.42	$0.50	$0.59	$0.68	$0.71	$0.85	$1.26	$1.40
Initial cost of pole	6.75	8.25	9.90	11.60	13.30	15.05	16.80	25.00	28.00
Cost of concrete per foundation	1.70	1.95	2.25	3.42	3.85	5.40	6.10	10.90	12.40
Labor cost per pole	2.10	2.20	3.00	4.00	4.50	5.10	6.20	7.00	7.80
Salvage value	1.62	1.98	2.38	2.78	3.20	3.61	4.04	6.00	6.72
Total cost per pole	9.27	10.84	13.27	16.83	19.13	22.65	25.91	38.16	52.88
Depreciation deposit per $1.00 @ 5 per cent	0.01505	.....	.....	.....	.....	.....	.....	.....	.....
Depreciation charge per year	0.140	0.163	0.200	0.253	0.288	0.341	0.390	0.574	0.896
Interest charge @ 6 per cent	0.556	0.652	0.796	1.01	1.15	1.36	1.555	2.29	3.17
Total annual charge	0.696	0.815	0.996	1.263	1.438	1.701	1.945	2.864	4.066
Cost per mile of 35 poles	24.37	28.56	34.82	44.30	50.30	59.50	68.10	100.40	142.00
Cost per mile of 18 poles	12.52	14.68	17.93	22.74	25.82	30.62	35.00	51.60	73.20

TABLE X.—COSTS OF A-FLEX STEEL POLES.

Stand side strain of 2,500 pounds. Factor of safety 2. Freight rate from Pittsburgh, Pa., to Columbus, Ohio, 12.6 cents per 100 pounds. Junk value taken as 60 cents per 100 pounds.

Length over all, ft	20	25	30	35	40	45
Depth in ground, ft	3	3	3	4	4	5
Weight per pole, lbs	210	260	320	370	450	510
Initial cost per pole	$5.25	$6.50	$8.00	$9.25	$11.25	$12.75
Freight cost	0.26	0.33	0.40	0.47	0.57	0.65
Labor cost	1.50	1.60	2.20	3.15	4.15	4.60
Concrete cost per foundation	1.50	1.75	2.00	2.30	2.55	2.75
Junk value as salvage	1.26	1.56	1.92	2.22	2.70	3.06
Total cost per pole	7.25	8.82	10.68	12.85	15.82	17.69
Depreciation deposit per $1.00 @ 5 per cent	0.01505	.....	.....	.....	.....	.....
Depreciation charge per year	0.109	0.133	0.161	0.193	0.238	0.266
Interest charge @ 6 per cent	0.435	0.53	0.64	0.78	0.95	1.06
Total annual charge	0.544	0.663	0.801	0.973	1.188	1.326
Cost per mile of 35 poles	19.08	23.20	28.06	34.04	41.50	46.40
Cost per mile of 53 poles	28.80	35.00	42.50	51.50	63.00	70.25

pull in just one direction. Then taking 100-foot spans for 35-foot poles there would be 13 triangulate and 40 "A-Flex" poles, making a total cost per mile of $55.42 as compared to $107.20 for the western cedar-pole line.

Such a steel line would be very durable and safe since the line with 100-foot spans would be in little danger of destruction by storm. The factor of safety would be much higher than for the wood-pole line and at the same time would not be subject to the danger from fire, a danger which is not negligible in many localities. The "A-Flex" pole has many commendable features for its adoption in telephone and telegraph and low-voltage power lines and would be worthy of further investigation on the part of public utilities using poles.

The tubular steel pole considered in this article is one put out by the Electric Railway Equipment Company, of Cincinnati, Ohio. The normal price of steel as quoted by that company is 2.25 cents per pound. These poles are extensively used for holding trolley-wire supports and lighting standards. Their use on telephone and power lines is yet very limited. The poles, as will be seen in the calculations, are made up in sections. The sections chosen are plenty large enough to stand the load as figured for the wood poles. The same items enter into the costs and annual charges as in the triangulate poles. The concrete costs evidently will not be so great since a much smaller square concrete foundation will be required for the tubular pole. These poles have a special reinforcing collar at the base for greater safety. It is seen that these poles come even cheaper than the steel triangulate poles. The curve of annual charges passes between the curves for the steel triangulate and the "A-Flex." Of course, in these calculations the freight rates from the different cities to Columbus, Ohio, causes some little difference. The rates on steel from Cincinnati are a little less than from Pittsburgh, yet the difference is only 2.6 cents per 100 pounds.

The cost per mile for tubular poles is figured on the basis of 35 poles, or poles 150 feet apart. The triangle-section pole is the tested-stress structure. The triangle is the only form whose shape cannot change without changing the length of one of the sides. The triangulate pole is recommended for spans of 300 feet on account of this characteristic but it is thought that the span of 150 feet is the most satisfactory for the tubular steel pole.

Concrete Piles.

The concrete pole is not yet used very extensively. It is in a state of experiment because it is not known just what effect age will have on it. Moisture absorption and repeated drying out seems to affect certain grades of concrete. However, many concrete poles placed in the past several years appear to be durable. It is thought that if good reinforced-concrete poles are made of the proper mixture they will last as long as steel poles properly maintained. The life of steel imbedded in concrete is practically indefinite. Concrete poles, of course, resist fire and do not fail abruptly if overloaded. The greatest disadvantage in concrete pole-line construction is that which deals with their manufacture. Concrete poles are of great weight and cannot be practically transported around the country like steel poles. It is the usual practice to make them on the ground where they are to be used. Problems of obtaining good sand and water arise, so that it can be seen that concrete-pole costs will vary with the community. The smaller sizes of poles, say up to 30 feet, are usually made on the ground in horizontal forms, then hoisted into place when set. The taller poles are usually made in their vertical position, the

TABLE XI.—COSTS OF TUBULAR STEEL POLES.

Price of steel 2.25 cents per pound. Freight rate from Cincinnati to Columbus, Ohio, 10 cents per 100 pounds. Junk value taken as 60 cents per 100 pounds. Life taken as 30 years. Weights and costs of coupling of sections figured in with initial cost.

Length over all, ft	20	25	30	35	40	45	50	55	60
Depth in ground, ft	4.5	5.0	5.0	5.0	5.5	6.0	6.0	8.0	8.0
Weight of pole, lbs	227	346	406	620	686	751	1,041	1,384	1,627
Sections used	15′ 4″	17′ 5″	18′ 5″	21′ 6″	20′ 6″	20′ 6″	20′ 7″	20′ 8″	25′ 8″
	6′ 3″	9′ 4″	9′ 4″	10′ 5″	15′ 5″	18′ 5″	20′ 6″	20′ 7″	20′ 7″
	.....	.....	6′ 3″	7′ 4″	8′ 4″	10′ 4″	13′ 5″	18′ 6″	18′ 6″
Freight cost	$0.23	$0.35	$0.41	$0.62	$0.69	$0.75	$1.04	$1.38	$1.63
Initial cost of pole	5.10	7.78	9.14	13.94	15.41	16.90	23.40	31.10	36.60
Cost concrete foundation	1.00	1.00	1.00	1.25	1.25	1.35	1.35	2.20	2.20
Labor cost per pole	2.10	2.20	3.00	4.08	4.60	5.20	6.40	7.50	8.00
Salvage value	1.36	2.08	2.44	3.72	4.12	4.51	6.25	8.30	9.76
Total cost per pole	7.06	9.27	11.10	16.10	17.83	19.69	26.14	33.88	38.68
Depreciation deposit per $1.00 @ 5 per cent	0.01505	.....	.....	.....	.....	.....	.....	.....	.....
Depreciation charge per year	0.106	0.140	0.167	0.243	0.268	0.296	0.393	0.511	0.582
Interest charge @ 6 per cent	0.424	0.555	0.666	0.966	1.071	1.181	1.569	2.034	2.328
Total annual charge	0.530	0.695	0.833	1.209	1.339	1.477	1.962	2.545	2.910
Cost per mile of 35 poles	18.55	24.28	29.14	42.40	46.80	51.60	68.70	89.00	101.90

forms being built up and reinforcing rods properly spaced by templates and the concrete poured in by means of a hoist. The drop of the concrete mixture into the mold insures a compact column all around the reinforcing rods.

The Pennsylvania Railroad Company, on the electrified division through Hackensack Meadows, installed concrete poles in heights between 35 and 60 feet. The mixture used was a 1:2:4, the mechanical bond bars being tied in a square skeleton frame covered by a minimum thickness of one inch of the concrete. These poles have an ultimate unit stress of 2000 pounds per square inch. The spans used were 120 feet. The 35-foot pole was designed to stand a top pull of 5300 pounds. This line is proving very satisfactory.

The usual shape of a concrete pole is square with bevelled edges above the butt. From the data sheet for concrete poles it is seen that the 35-foot pole is 6 inches at the top and 12 inches at the bottom. About 8 one-half-inch twisted steel rods would be placed in rows through the section so that no rod would be covered with less than one inch of concrete. The pole would not begin to taper until about 9 feet from the bottom, from which height the bevel on the corners would also start to give the pole a neat appearance.

The figures used in regard to the quantity of material for the poles of different height have been taken from Gillette's Handbook. The costs as given in his data appeared so low that they seemed below the normal, so that the concrete, steel, and labor have been computed on what is thought to be a normal basis. The life of the concrete pole is taken at 30 years for the same reason as given for the life of a steel pole, namely, uncertainty as to line removal or to pole removal due to increased capacity required.

It is seen that the concrete pole compares favorably with the steel poles, being even lower in annual charges on the smaller heights. The annual charge for the 35-foot pole is $1.036 as compared to $1.263 for the triangulate and $2.022 for the western cedar. In figuring costs per mile in annual charges 42 poles per mile have been used, equivalent to a span of 125 feet. It is thought that this is the safest span to use for concrete poles because they are not so elastic to undue strains as the steel poles. The elasticity due to the unbalanced loads may cause the concrete to crack and thereby open recesses for decay from the weather.

One item omitted in the calculation of annual charges for concrete poles that was counted in the steel-pole calculations is that of salvage.

Conclusion.

As was stated at the beginning of this article, the results arrived at do not apply to all conditions of the country, or not even to all streets in the same communities. For instance, if wooden poles were set in rock, about $4.70 per pole would need to be added to the labor cost; if they were set in sidewalks, about $3.40 would need to be added. It also makes a great difference where the concrete foundation for a steel pole is to be built. Evidently in the mountains of West Virginia where materials would need to be carried on mule back, concrete would not be figured at $6.00 per cubic yard.

It is thought that the prices given as initial cost of poles are fair ones and that prices among different companies for similar kinds of poles are nearly the same, also that cost of preservative treatment by specification "AA" will not differ very much among companies dealing in treated poles.

The results of this comparative study show that there is considerable gain in the way of annual charges if treated poles are used in the line. Public utilities in using treated poles will not only be acting in harmony with the conservation plans put on foot by the Government but will be actually saving money in the investment. The wooden pole always will be commendable for pole-line use because of its ideal outline, if well selected, to resist stresses, since those encountered by a tree in natural life are much the same as those encountered in pole-line service. The wooden pole has equal strength in all directions, large strength in torsion, and considerable elasticity to equalize unbalanced loading. This is obtainable in steel and in concrete to a lesser degree, especially in regard to concrete.

ELECTRICALLY OPERATED SHIPS AS AUXILIARY TO THE MERCHANT MARINE.

Edward N. Hurley, chairman of the United States Shipping Board, at the suggestion of Senator Charles L. McNary of Oregon, has tentatively approved a plan for the construction by private concerns of 150 motor-driven ships of 3000 tons each for use in our merchant marine. The proposed construction program is not to interfere with the construction work of the Emergency Fleet Corporation.

The plans contemplate the equipment of the motor ships with Diesel engines, electric generators and motors, requiring no machinery and material used in equipping steamships, such as boilers, steam piping, smoke stacks and propeller shafts. Chairman Hurley has given his conditional consent that wooden shipyards, not engaged in building wooden ships for the Government, shall be free to enter into contracts to build such proposed motor ships for private owners. All such ships are to be built by American organizations, and are to sail under the United States flag.

TABLE XII.—COSTS OF CONCRETE POLES.

Figured as built on ground where used. Taller poles built upright, smaller ones not. Steel costs taken as 1.6 cents per pound. Poles set 125-foot spans. Cost of concrete taken at $6.00 per cubic yard. Life taken as 30 years.

Length over all, ft	25	30	35	40	45	50	55	60
Depth in ground, ft	4.5	5.0	5.5	6.0	6.5	6.5	7.0	7.0
Top width, in	6	6	6	7	7	7	7	7
Bottom width, in	10	11	12	15	16	17	18	19
Size steel rods used, in	¾	⅞	1	⅞	⅞	⅞	1	1
Cost of steel	$1.58	$2.29	$3.92	$6.31	$8.56	$9.50	$13.34	$14.56
Cubic feet of concrete	16	21	26	36	43	50	56	61
Cost of concrete	$3.56	$4.57	$5.78	$8.00	$9.55	$11.10	$12.45	$13.58
Cost of binding	1.20	1.20	1.20	1.50	1.50	1.80	1.80	1.80
Labor cost	1.70	2.20	2.70	4.20	5.70	7.20	8.95	11.70
Total cost	8.04	10.26	13.60	20.01	25.31	29.60	36.54	41.64
Depreciation deposit per $1.00 @ 5 per cent	0.01505	.....	.....	.....	.....	.....	.....	.....
Depreciation charge per year	0.121	0.154	0.221	0.301	0.381	0.445	0.535	0.625
Interest charge @ 6 per cent	0.482	0.615	0.815	1.20	1.52	1.774	2.19	2.50
Total annual charge	0.603	0.769	1.036	1.501	1.901	2.219	2.725	3.125
Cost per mile of 42 poles	25.30	32.30	43.50	63.10	80.00	93.20	114.50	131.40

Operating Features of Three-Phase Four-Wire Distribution

Discussion of the Economies, Advantages and Precautions Accompanying Distribution of Three-phase Energy Over Four Wires

By GEORGE E. WAGNER.

Superintendent of Plant, Madison Gas & Electric Company.

IN THE early days of alternating currents in the electrical industry, the current was generated and distributed single-phase. Polyphase generation and distribution were developed later and in about 1888 two and three-phase motors and generators made their commercial appearance. At first two-phase current was preferred for general use and three-phase current was used only for long distance transmission. After a short time three-phase current became more popular and the tendency has been toward its exclusize use for general power purposes.

Three-phase current distribution was at first carried on over three-wire circuits. In this system transformers for lighting purposes are connected between any two lines and for three-phase power they are connected in delta on both primary and secondary side. This connection is shown on Figure 1 and is generally referred to as the delta-delta connection.

Shortly before 1900 three-phase, four-wire distribution was developed, no doubt, a direct outgrowth of three-wire distribution, increasing the line voltage, thereby reducing size of wire and the amount of copper required, and still permitting the use of the same step-down transformers used for the three-wire system. In this system the transformers for polyphase

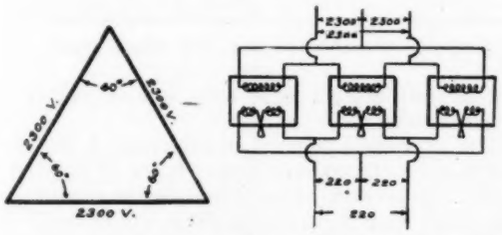


Fig. 1.—Three-phase Delta-delta Connection of Transformers.

use are connected in "Y" or star on the primary side and in delta on the secondary side. This connection, shown in Figure 2, is generally called the star-delta connection. The voltage on the transformers is the same as on the three-wire system and, therefore, the secondary voltage is also the same. For single-phase use transformers are connected between a phase wire and the neutral as shown in Figure 3. The neutral point should be grounded.

The three-phase, four-wire system has since 1900 been adopted by many cities which have remodeled their distribution systems or have developed new systems.

At the present time there are still three methods of distributing high voltage alternating current, namely, single phase, two phase, and three phase. In both two-phase and three-phase there are three-wire and four-wire systems.

Economy of Four-wire Circuit.

In comparing these various methods of distribution it is essential to first consider the initial cost, the largest item of which is the copper. Assuming the weight of copper required for a single-phase circuit as 100 per cent, the amount of copper required for the various systems for the same load would be as follows:

Method of Distribution.	Per cent copper.
Single-phase system	100.0
Two-phase, four-wire system	100.0
Two-phase, three-wire system	72.9
Three-phase, three-wire system	75.0
Three-phase, four-wire system (4 wires)	33.3

If a four-wire circuit is used for three-phase power only, only three wires are necessary, requiring only 25 per cent of the copper of a single-phase circuit. The tabulation above is based on using the same voltage on step-down transformers. The maximum voltage has different values depending upon the system used.

The three-phase, four-wire distribution in general use is the 2300/4000 volt system, so called because

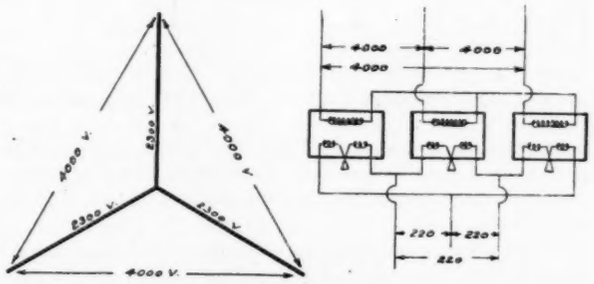


Fig. 2.—Three-phase Star-delta Connection of Transformers.

the voltage between any phase wire and the neutral point or neutral wire is about 2300 volts, and between phase wire 4000 volts. Since the voltage to neutral is the same as was used for the three-wire system, the same transformers can be used.

Since the line voltage in the four-wire system is 1.73 times that of the three-wire system, and the line current is proportionately less, and the line drop directly proportional to the line current, it follows that the size of wire required for the same load and with the same permissible loss is one-third of that required for three-wire distribution.

From the above it follows that if a three-wire 2300-volt circuit is converted into a four-wire 2300/4000-volt circuit, the capacity of the circuit for the same voltage regulation is tripled. If this circuit is to supply any individual single-phase transformers, however, then the fourth or neutral wire should be strung

in. It is possible to use the ground as the neutral return but it is generally considered more satisfactory to use the fourth wire.

From the above it also follows that if two single-phase 2300-volt circuits are combined into one four-wire 2300/4000 volt circuit, the capacity of the three-phase circuit is three times that of the two single-phase circuits combined.

For example, we will calculate the amount of electric energy that can be transmitted a distance of 5000 feet over No 2 copper wire with a line drop of 92 volts between the generator and the load, the phase voltage to be 2300 volts. The resistance of No 2 copper wire is 0.156 ohms per 1000 feet, and the resistance of one single line would be five times that or 0.78 ohms.

In a single-phase circuit the drop in voltage would be twice the drop in one line. The circuit would then transmit $\frac{92}{.78 \times 2}$ or 58.9 amperes or about 135 kilovolt-amperes.

In a three-phase, three-wire circuit the drop in voltage would be 1.73 times the drop in one line. A circuit of No 2 wire would then transmit $\frac{92}{.78 \times 1.73}$ or 68.2 amperes or about 275 kilovolt-amperes.

In a three-phase, four-wire circuit with a balanced load the drop in voltage would be the drop in one line only. This circuit will then transmit $\frac{92}{0.78}$ or 118 amperes or about 810 kilovolt-amperes.

As the number of wires required for the above systems are 2, 3 and 4, respectively, the amount of copper required under the three conditions would be in the ratio of 2 to 3 to 4. The calculations show, however, that the amount of power that can be transmitted varies in the ratio of 2 to 4 to 12.

While the increased line voltage is advantageous insofar as it requires less copper, it must be viewed from another angle less beneficial. If branches of trees are permitted to extend through the line between phase wires, they will cause leakage—particularly in wet weather—frequently causing one or more wires to burn off. The increased voltage must also be taken into consideration on underground work. If two two-conductor cables are used for a three-phase, four-wire underground circuit the insulation of one pair must be sufficient for 2300 volts and of the other pair for 4000 volts.

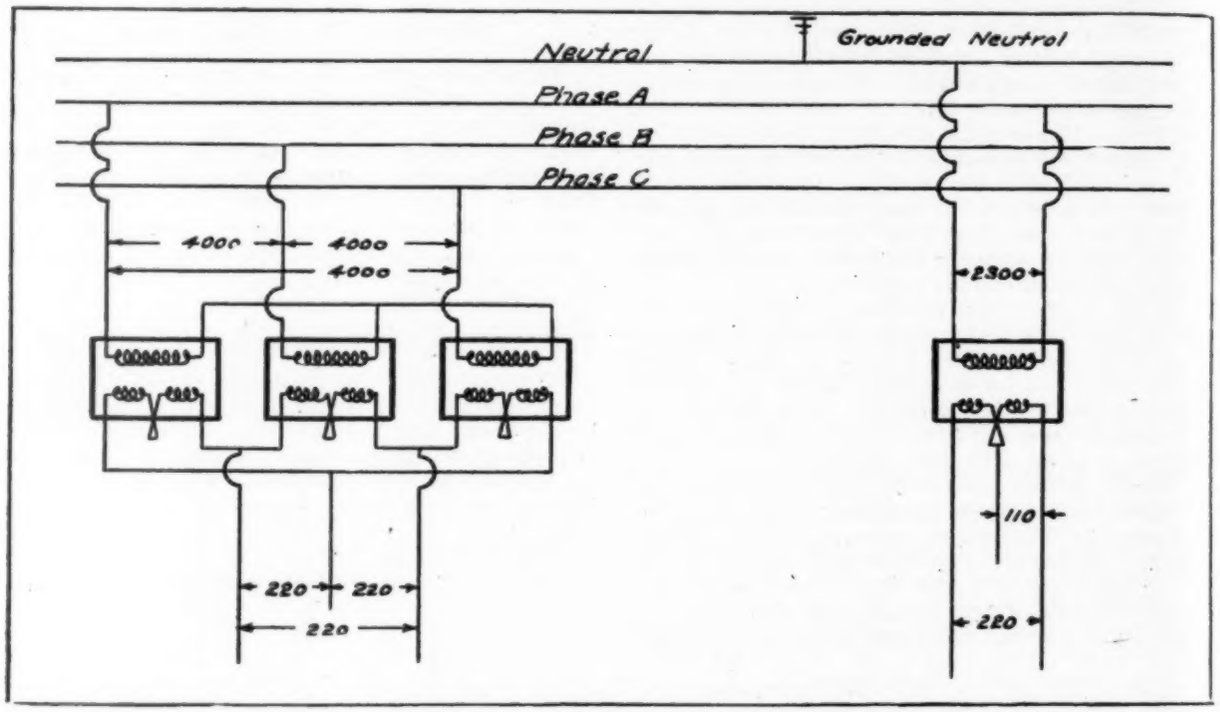


Fig. 3.—Three-phase Four-wire Circuit Showing Bank of Three Single-phase Transformers and One Single-phase Unit.

The grounded neutral and increased line voltage must also be considered in the choice of lightning arresters. On account of the grounded neutral, a ground on a phase wire will be a short on the circuit. When linemen work on a three-phase, four-wire circuit they must bear in mind that they are working on a higher voltage than on a three-wire line, with the same voltage for transformers. The grounded neutral protects the circuit against a possibility of a voltage higher than the phase voltage to ground. This should, therefore, be considered as a safeguard and no disadvantage.

Transformer Connections.

In both three-wire and four-wire systems it is possible to supply three-phase current from two transformers only, with an open-delta secondary. If only two transformers are used on a four-wire circuit, the neutral point of the transformer bank must be connected with the neutral wire. Without this connection the two transformers would simply be in a series across 4000 volts and would deliver a single-phase current only.

When three transformers are used on a four-wire circuit the neutral point of the transformer bank

should be isolated except in special cases, that is, it should have no connection with the neutral wire of the circuit or the ground.

Some companies have tried to connect the primary neutral point of transformer banks which supplied a comparatively large single-phase load in addition to a three-phase load. To take care of the unbalanced load a larger transformer was installed in the phase supplying the single-phase load. The primary neutral wire was then connected, with the idea that it would take care of the excess primary current for the larger transformer instead of having it pass through the windings of the smaller transformers. An example of this condition would be a consumer requiring single-phase current for spot welders and three-phase current for a few motors.

Laboratory tests have shown, however, that under the conditions cited above the primary neutral carried practically no current. The tests showed that if a single-phase load is supplied from one-phase of a three-phase bank of transformers, the other two transformers act as one single-phase transformer operating in parallel with the transformer on the loaded phase and share the load with it. The oscillograph showed that the current through the primary winding of the large transformer divided and part of it passed through the primary winding of each of the other two transformers. The current waves of the current in the two transformers were about the same, exactly in phase and just 180 electrical degrees from the current in the transformer on the loaded phase.

These tests also showed that the current in the neutral wire was practically zero so long as the voltages were balanced. As soon as the voltages were unbalanced in the secondary delta, a circulating current was set up in the delta and a flow of current in the neutral wire of the primary current occurred.

Moreover, they showed that when a single-phase load was supplied from one phase of delta-connected secondaries, the load was distributed over the three transformers, the transformer on that phase supplying about one-half and the other two together the other half. The exact proportions of the load supplied by each seemed to depend upon the power-factor of the circuit. The tests also showed that the three transformers divided the single-phase load in about the same proportion whether the primary neutral was connected or isolated.

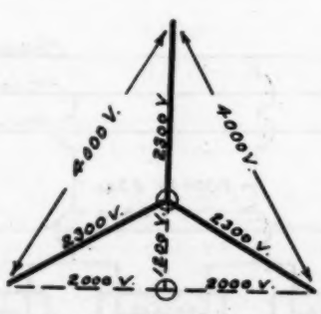


Fig. 4.—Line Diagram Showing Distortion of Star Voltage Due Open Neutral With Unbalanced Loads in Phases.

The results of these tests were verified in the field on a bank of transformers supplying a 200-ampere, three-phase load, and in addition two 100-ampere spot welders from one phase. Every time a spot welder came out it drew current from all three transformers. The current in the neutral caused by the welders coming on was practically nothing. A comparatively heavy current was set up in the neutral wire, however, when the operator at the station varied the voltage on one phase with the feeder regulator.

From the above it follows that there is no occasion for installing in a bank of transformers supplying three-phase power plus an additional single-phase load, one transformer with a capacity larger than the capacity of the other two combined. Inasmuch as the neutral wire carries practically no current there would under such conditions be an excess current in the windings of one or both of the smaller transformers, if the larger transformer carried full load. In determining the sizes of transformers necessary for an installation like the above, it should be borne in mind that the transformer on the phase supplying the single-phase load actually supplies only about one-half of the single-phase current while the other two supply the balance.

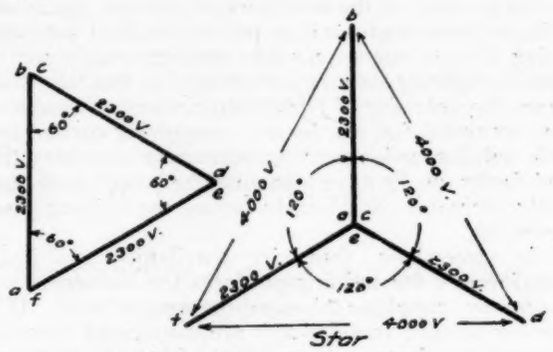


Fig. 5.—Line Diagram Showing Voltage Magnitudes and Relations With Delta and Star Connected Transformers.

From the above it also follows that the primary neutral point of three-phase transformer banks should be isolated unless the transformers have ample capacity to take care of their regular load plus any circulating current that may be set up on account of an unbalanced voltage condition. If one phase wire should develop a ground the voltage on that phase would naturally drop on account of the heavy current. The transformer bank with the primary neutral connected would immediately tend to equalize the voltages on the three phases. The other two transformers would draw a heavy current on their phases trying to boost the voltage on the grounded phase. The probable result would be that the primary fuse of one transformer would blow and the other two would then carry the load on open delta. If the capacity of the other two transformers was insufficient they would be overloaded and would be liable to be damaged.

If the primary neutral point of a transformer bank is isolated there is no circulating current caused by unbalanced voltages, but if one blows a fuse the other two transformers are actually in series between two-phase wires—their secondary voltages are one-half of the normal voltage times 1.73, about 200 instead of 220, and the voltage across the secondary and primary of the transformer with the fuse blown is zero when the load is straight resistance or single-phase load. If there are any three-phase motors on the circuit they will run and their windings will tend to keep up a delta voltage. If these motors are stopped they will as a rule not start because it would be equivalent to trying to start them on a single-phase current.

One of the greatest advantages of three-phase, four-wire distribution is its successful use for both

light and power purposes regardless of load balance. If a single-phase feeder regulator is installed in any phase it can be adjusted to give a constant voltage at any point on the line regardless of the load on the other phases. In fact, one method of developing a four-wire circuit is to supply all the single-phase lighting load from one phase and equip this phase with a feeder regulator. When the lighting load increases it can be distributed over all three phases and feeder regulators installed in them.

On account of the simplicity of voltage regulation a three-phase, four-wire circuit can be used for supplying all the current for any district, whether it is used for lighting, heating, or power. It thereby overcomes the necessity of paralleling circuits and reduces the investment for any district. Supplying current for both lighting and power purposes also increases the load-factor on the circuit because the power load generally decreases considerably before the lighting peak comes on.

In three-phase, four-wire distribution individual transformers for lighting purposes are connected between any one phase wire and the neutral wire. If a number of such transformers are distributed over the three phases there is a possibility of trouble from another source. Under this condition the current in the neutral wire is the vector sum of the current in the phase wires. If the neutral wire should at any time open between the station and the load, an unbalanced load on the phases would cause an unbalance in voltage which might be disastrous to lamps burning in the circuit at the time.

The current in the primary winding of a transformer increases as the secondary current increases because the actual reactance in the primary decreases. Therefore, if two phases were heavily loaded and one phase had almost no load and the neutral wire went down, the difference in reactance would cause the neutral point of the circuit to be drawn out of center, as shown in Figure 4, the transformers on the loaded phases would then be practically in series between phase wires, and deliver a secondary voltage of nearly 100 and 200 instead of 110 and 220. The transformers on the phase carrying very little load would then have a voltage of about 3500 volts impressed upon their primaries and their secondaries would deliver 175 and 350 volts instead of 110 and 220 volts, with the probability of the central station having to replace a lot of lamps. In Figure 4 the correct voltages are indicated by full lines and the distorted voltage condition is shown by the dashed lines.

The probability of such a case of trouble can be reduced by carefully distributing individual lighting transformers over the three phases with a view of keeping the load fairly well balanced. The possibility of such a case of trouble can be overcome by supplying all of the single-phase lighting transformers from one phase, but the most satisfactory method of overcoming this danger seems to be to ground the neutral wire not only at the station but at several places along the line. The ground connections would serve as a path in parallel with the neutral wire and if the neutral wire broke down anywhere the ground would take care of the unbalanced load and prevent sufficient distortion to do any damage. With a good ground connection there should be practically no distortion whatever. The locations for grounding must be selected with great care to guard against picking up stray currents. In localities where a ground connection would be liable to pick up excessive stray currents it would be advisable to guard against a break in the neutral wire by tying the neutral wires of different circuits together wherever such connection could be made conveniently. This method would almost eliminate the possibility of an open circuit in the neutral wire. Circuits supplying outlying districts can generally be grounded without danger from picking up stray currents.

In changing from three-phase, three-wire to three-phase, four-wire distribution the first consideration is,

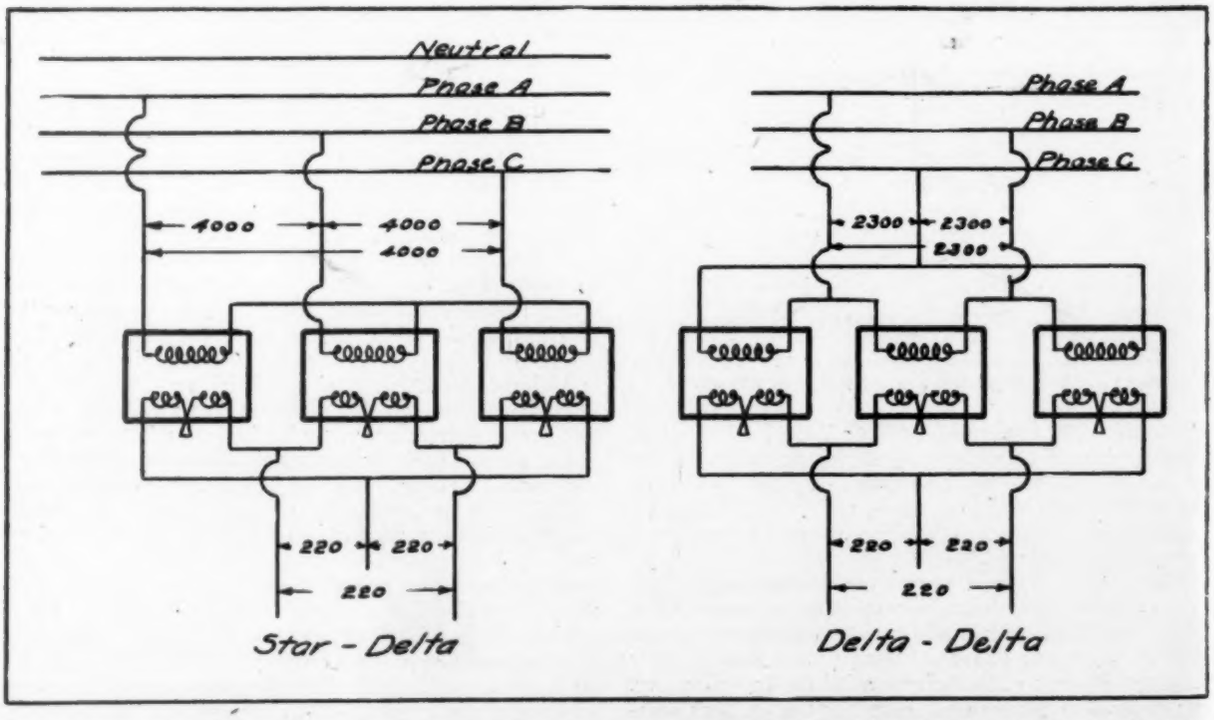


Fig. 6.—Three-phase Four-wire and Three-phase Three-wire Circuits With Transformers Connected for Three-phase Supply.

of course, the higher generator voltage. If the winding of a 2300-volt, three-phase generator is connected in delta, it can be connected in star and if the insulation is sufficient, can be used for 4000 volts. If the generator is already star connected it would have to be rewound. The all-important requirement on the line is to make sure that when the change is made in the transformer connections the phase relations will not be changed, in order that the rotation of three-phase motors will not be reversed. Figure 5 shows the change from delta to "Y" connection which will not disturb the phase relations.

Figure 6 shows the actual change in connections in the field in changing a bank of transformers from a delta-delta to a star-delta connection. The connections

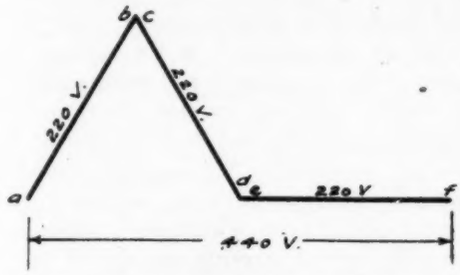


Fig. 7.—Diagram Showing Effect of Reversed Phase on Secondary Delta.

on the secondary side are not disturbed. The simple rule is that all the right-hand primary legs or all the left-hand primary legs are connected to the neutral point, and the other legs are connected to phase wires.

It might be well to caution against reversing the secondary side of any one transformer in connecting a new bank. Such connection would be equivalent to throwing a short on a voltage equal to twice the phase voltage, a condition shown in Figure 7.

If an attempt were made to close the secondary delta with the primary current on it would be equivalent to a short circuit on 440 volts.

Summary.

(1) On account of the increased voltage in the three-phase, four-wire system, the amount of copper required for transmitting the same load over the same distance is very much less than is necessary for any of the other systems.

(2) The change to the four-wire system does not cause a change in voltage on the step-down transformers, thereby permitting the use of the same transformers.

(3) The four-wire system can, on account of the "Y" connection and its simplicity of regulation, be used for supplying current for light, heat, and power purposes from one circuit, thereby overcoming the necessity of parallel circuits. This produces an additional saving in copper.

(4) In order to protect all parts of the circuit against excessive voltage to ground, and to protect single-phase lighting transformers against excessive voltage, the neutral wire of a three-phase, four-wire circuit should be grounded not only at the station but at a sufficient number of points along the line.

(5) The neutral point of three-phase transformer banks should be isolated.

(6) When the neutral point of a three-phase transformer bank is connected with the neutral wire of the circuit, the delta connected secondaries tend to equalize the phase voltages. This should, therefore, not be done except on transformers of large capacity.

(7) If a single-phase load is supplied from one phase of the delta connected secondaries of a three-phase bank of transformers, the transformer on that phase will supply about one-half of the single-phase current, and the other two transformers will supply the balance, whether or not the primary neutral point is connected to the neutral wire.

In conclusion it might be well to emphasize that the principal advantage of three-phase, four-wire distribution is the combination of the increased line voltage and Y connection. The Y connection without an increased line voltage would require as much copper as a single-phase circuit. The increased line voltage without the Y connection would sacrifice the simplicity of regulation and consequent advantage for supplying current for light, heat, and power from one circuit.

TELEPHONE GIRLS TRAINING FOR SERVICE IN FRANCE.

Chicago Telephone Company Conducts School to Instruct Operators for Army Service Abroad.

A form of war activity that is little heard of, but that is of particular interest to the electrical industry, is the training of girls for positions as telephone operators in the war zone. Already 33 patriotic American girls have departed for France and this number is being increased every day.

The accompanying illustration shows a group of Chicago girls taking the course offered by the Chicago Telephone Company. This training is being given by the company after the young ladies have passed an examination by the Government to determine whether they are sufficiently fluent in French.

Group of Telephone Operators Taking Course for Service in War Zone.

This class is being constantly augmented by fresh arrivals and every few days one or more of the girls finish the course and leave for an eastern port of embarkation to start for France.

Editorial Comment

Three-Phase Four-Wire Distribution

FOR general city distribution of power and lighting from the same circuits, excepting perhaps in the most congested down-town districts of the large cities where direct current has apparently become the custom, the three-phase four-wire circuit has come steadily to the fore. It is the circuit par excellence for mixed service, economical, flexible and reliable, all being obtained coincidentally.

The salient features of the four-wire three-phase circuit are that with standard distributing transformers energy may be transmitted at 4000 volts and distributed at 2300 volts; it uses 33.3 per cent of the copper and the three-wire circuit but 75 per cent required by the single-phase two-wire circuit; by connecting single-phase loads between phase wires and neutral and three-phase loads between phase wires it is possible to regulate the voltage of each individual phase according to its length and load without seriously affecting the three-phase supply in the way of voltage regulation or unbalance, provided the neutral point of the star-delta three-phase transformer bank is not tied in. The four-wire circuit offers less likelihood of service interruptions to lighting loads than does the three-wire circuit, for if one phase breaks down the other two phases and neutral are still able to supply their respective single-phase loads without cognizance of the failure of the other phase, provided the neutrals of power banks are not tied-in to neutral; this is a matter of extreme importance should a phase break down during the evening lighting period, since it means virtually one circuit down instead of two, until the loads of the phase in trouble can be cut over to some other phase or circuit or till repaired.

Elsewhere in this issue appears a discussion of some operating and economic aspects of four-wire three-phase distribution. Emphasis is placed upon not tieing in the neutral of three-phase transformer banks on the score of reliability. It might be pointed out that so long as the low-voltage side of these three-phase transformer banks are connected in delta the necessity of connecting in the neutral point in the high-voltage side disappears as the secondary serves the same equivalent purpose, namely, furnishes a circuit for the exciting current, and without fear of distorting the wave-form as would occur if the neutral point was open and the secondary not a closed circuit. Moreover, to tie in the neutral with the delta closed is to short-circuit the third harmonic exciting current and its multiples in the primary, a condition tending toward inductive interference to neighboring circuits as well as reduced capacity of conductors and transformers and phase unbalance under conditions of unequal load and length of phases of the single-phase circuits.

The recommendation that the neutral conductor be grounded at frequent points along the circuit, and that the neutrals of different circuits be actually connected together at intervals along their path will doubtless meet with criticism by engineers operating some of the largest four-wire three-phase distributing networks in existence. At least one company, with the largest four-wire system in the world, carefully isolates and insulates its neutrals except at one point, the neutral of the transformers in the station, where a good ground can be attained and maintained. Moreover, it installs lightning arresters along its lines between neutral and earth, and its linemen treat the neutral as a live conductor. A frequently grounded neutral not only tends to pick up vagabond currents, whether for city or urban distribution, which will tend to reduce the current-carrying capacity of the circuit, but may cause phase unbalance and will interfere with, and may even jeopardize, voltage reduction when accomplished automatically by contact-making voltmeters of the compensated type or with line drop compensators.

The Boston Street Lighting Decision

CLOSE observers of the progress of the Boston street lighting rate case before the Massachusetts Gas and Electric Light Commission will not be surprised at the recently announced finding of the board in favor of the city. The company fought a remarkable battle, but it was committed to the defense of a cost estimate of too great elaboration. The Commission intimates this in its finding by refraining to deal with the subject-matter of the case at length along the lines analytically followed by the contestants. The failure of these elaborate cost data to win the case for the company follows out some of the thoughts expressed editorially in this journal during the most active part of the case and indicates that it does not pay to go too far into theoretical cost assumptions in handling rate cases of this kind.

The price reductions recommended by the Commission will, it is estimated, save the city something like $600,000 in the 10-year life of the contract signed in 1914. The most interesting price change is from $87.53 to $79.60 per year of 3828 hours' operation for 500-watt direct-current magnetite arc lamps. The new series incandescent prices will be $15.92 for 40-candlepower lamps; $17.69 for 60-candlepower; $22.94 for 80-candlepower, and $29.98 for 100-candlepower units. These incandescent rates strike one as pretty low in face of present coal and labor costs, but the finding represents the board's best endeavor to establish a fair return for the service as a whole. It is to be remembered that a very large number of lamps is involved in

this ruling, no less than 4543 magnetites and nearly 4000 series incandescents having been in service at the time the contract was signed, with subsequent additions to which the new rates will apply. The city made an extraordinarily able attack upon the company's theory of costs and the municipality had the services of one of the best known electrical engineering professors in New England at its disposal. The "drive" against the company's cost structure brought out the uncertainties of the assumptions at various points, and it proved impossible to convince the board that the company's estimate of costs was unassailable. The city conceded the soundness of basing the price for the service upon its cost, it is true, but it examined item by items all the expenses and property exhibited by the company and challenged many of them either as to their inclusion at all or the reasonableness of the company's expenses and property costs, or the theories of the apportionments of expenses or property common to street lighting and the commercial use of electricity.

The nub of the board's discussion of theoretical costs lies in the following words: "When it comes to the investment and expenses common to the company's entire system and business, any assignment to the city of a definite share in each item depends primarily on the assumed necessity of making such assignment. The mind then addresses itself to this specific task, item by item, and involves the adoption of theories which, however plausible, have had little influence in the development of the company's property. The careful examination of every detail of the company's affairs during these long hearings made it clear that, had the company never lighted the streets of Boston, there is little, if any, of its plant other than that devoted exclusively to the service with which it could or would have dispensed. Even while the case was pending the growth of the commercial business changed substantially the ratio of the city's demand to the company's peak—a ratio used repeatedly in determining and stating with "illusive inexactness" items of investment and expense attributable to the city. Neither party sought to measure the "fair price of the entire service" by its cost if independently performed, and both parties recognized the community of interest alluded to in dealing with the generating and transmission expenses. A recognition of a similar community of interest in dealing with all investment and operating costs, which are so indistinguishably associated with the entire business, will permit the city to enjoy the advantage of this association, but without discrimination either in its favor or in favor of any other customer or class of customers." The board sees no need of reaching merely a theoretical estimate of an assumed investment for Boston street lights on the day the contract became effective.

Nothing in the decision justifies the belief that there is no use in trying to determine the cost of a particular service in a commission proceeding of this kind; but the wide gulf between the actual, visible costs of a service and of costs pro-rated to it is most apparent. Trimming, patrolling, renewing and repairing lamps and fixtures, and the energy delivered to the lamps are costs of the first order. Granted, of course, that overhead charges and administrative costs also apply to street lighting outlay yielding a fair return to an operating company for its plant and efforts engaged in such work, it none the less follows from the Boston decision that it is of doubtful value to proceed anything like as far on the basis of assumptions as on the basis of more readily ascertained facts. In other words, the lesson for the utility in street lighting negotiations seems to be this: Set down the demonstrable costs of the service as fully as possible, but do not spend too much time upon the elaboration of the remaining assumed costs which make up the total, but which are intrinsically indefinite in character.

For the Cause of the Vacuum Cleaner

SPRING-CLEANING time is here. With the coming of warmer weather, moving and longer hours of sunshine, houses are thrown open, storm windows are taken down, and the fresh air of Springtime is allowed to enter homes barricaded for so many months against the outdoor air. And with spring-cleaning crusades comes pneumonia and sickness, for the germ-laden dust of indoors is more deadly than the blast and exposure of the outdoors. And when the annual spring cleaning occurs, dust long laid latent is scattered around, covering materials and mouths with disease-breeding germs, and sickness often follows.

It is claimed that dust and dirt and the germs harbored and scattered by them are the greatest cause of illness in the home, and the chief source of infection and fatality to those going about housework. It is now thought that scourge, infantile paralysis, may be communicated by dust-borne germs from road and floor. As deadly as the Hun abroad are the microbes harbored in the dust at home, and more numerous and tireless are they in their myriads. While vanquishing the enemy abroad, no effort should be spared therefore to exterminate the enemy at home, an enemy unseen yet virulent.

Spring-cleaning time should be vacuum cleaner time, for the vacuum cleaner is the simplest safeguard against the unseen hordes of microbes that find harbor in cracks and crevices and make every speck of dust a menace. The vacuum cleaner collects the dust and dirt where other methods scatter them broadcast. The vacuum cleaner saves work, where other methods make it. The vacuum cleaner is the housewife's best friend for it enables the home to be kept cleaner and cleaned easier, it makes house cleaning safer, healthier, more thorough and less unpleasant.

The vacuum cleaner is a friend, indeed. And its use, like a woman's work, is never done, because housecleaning goes on and on, and will go on as long as there are families and homes. Help the vacuum cleaner along.

Week's Events

Activities of Committee on Electric Service—Signaling-Apparatus Section Formed—Water Power Legislation Urged

CONTRACTOR-DEALERS TO HOLD ANNUAL CONVENTION.

Newly Organized Association Will Meet in Cleveland in July.

At the recent meeting of the executive committee of the National Association of Electrical Contractors and Dealers held in Detriot, Mich., it was tentatively decided to hold the annual convention in Cleveland, Ohio, beginning the week of July 15. The Hollenden Hotel will probably be the headquarters for the convention.

The meeting of the executive committee was a very successful one, and was held coincidently with the convention of the Michigan State Association of Electrical Contractor-Dealers. On Monday noon a luncheon was given in honor of the executive committee by the Detroit Electric Club, at which Joseph A. Fowler, of Memphis, Tenn., and W. A. Tuohey, of Springfield, Mass., were the principal speakers. On Monday night, a meeting of 250 contractors was held in St. Andrew's Society Hall, at which addresses were delivered by Chairman Peet, James R. Strong and William L. Goodwin, all of New York. On Tuesday, a banquet was held at the Statler Hotel, at which the same speakers were called upon.

The executive committee meeting was devoted very largely to the presentation of committee reports, indicating considerable progress in the reorganization plans of the association. The meeting was considered the most successful held so far by the committee.

NEW YORK ELECTRICAL SOCIETY OBTAINS 500 NEW MEMBERS.

Big Membership Drive Results in Securing Desired Quota Before Expiration of Time Set.

With a margin of nearly two months to spare the New York Electrical Society has closed its membership campaign, the 500 new members having been secured.

Last fall it was decided that during the winter and spring the Society should increase its strength by 500. Accordingly a Membership Committee was appointed and plans were laid for an energetic campaign. A thermometer showing 500 degrees was designed to record the progress of the campaign and the slogan, "Over the Top by June 1," was adopted.

Different members of the committee directed the campaign among the branches of the industry which they represented, with the result that the Society now includes in its membership some of the foremost electrical men of the central-station industry, as well as experts in telegraph, telephony, street-railway operation, the electrification of steam railways and manufacturers of electrical goods.

At the meeting of the Executive Committee held April 4, the results of the drive were disclosed and received with marked enthusiasm. The chairman of the Membership Committee stated that although the long coveted ambition of his committee had been realized, the encouragement of new enrollment would not cease. Before the meeting adjourned, a resolution thanking the members of the Membership Committee for their "unexampled efforts and splendid success in building up the membership of the Society" was unanimously adopted. Each committee member will receive a copy of the resolution.

OHIO ASSOCIATION TO HOLD CONVENTION.

Annual Meeting at Cedar Point, O., July 10, 11 and 12.

There will be a convention of the Ohio Electric Light Association at Cedar Point this year, and so far as now known the time will be July 10th, 11th and 12th. The time is yet to be officially fixed by the Executive Committee.

At the meeting of the committee held in Columbus recently, after full consideration, it was unanimously voted to hold a convention this year, under modified conditions, however, as to expenses and entertainment. It was thought by the committee that all efforts that entail entertainment or extraordinary expense should be discontinued in these times of war, but that a convention at which the members of the Association could again meet and discuss the problems that are facing the industry was highly necessary.

In discussing the decision of the Executive Committee, D. L. Gaskell, secretary of the Association says, "The action of the committee is to be greatly commended. At no time in the history of the industry is it more necessary to get together frequently and consult upon measures that are necessary to conserve the industry and assist the government in the prosecution of the war. No branch of business has done more to assist the government than utility men and in order that we may exert our fullest force in this direction we would have frequent consultations as to measures and other matters."

WISCONSIN CONTRACTOR DEALERS WILL MEET AT MADISON.

Quarterly Meeting April 23-24 Will Consider Overhead Expense and Trade Acceptances.

The Wisconsin State Association of Electrical Contractors and Dealers will hold its next quarterly meeting at Madison April 23 and 24. The program, as announced by John A. Piepkorn, state secretary, Milwaukee, provides for a talk on "Trade Acceptances," and a discussion of the subject; the subject of "Why the Electrical Contractor Should Become a Merchandiser" will be handled by a man who has found out why. Other matters to receive attention are: "Selling Electrical Appliances on the Installment Plan"; "Overhead Expenses in Our Business," and "Industrial Lighting." This organization has about 100 members.

COMMITTEE ON GAS AND ELECTRIC SERVICE ACTIVE IN COAL SITUATION.

Aids Government in Working Out a Feasible Zone System for Coal Distribution.

It is reported by the National Committee on Gas and Electric Service that the United States Fuel Administration, in co-operation with the Director General of Railroads, announces a zone system to govern the distribution of bituminous coal during the coal year beginning April 1, 1918. This zone system is described elsewhere in this issue.

In view of national necessities and of the serious danger of another coal shortage the United States Fuel Administration and the United States Railroad Administration have devoted several months to the study of what can be done to remove the causes which have hampered the enlargement of coal production. It has been found that in a substantial sense the country has been engaged in "carrying coals to Newcastle." Cars and locomotives have been occupied for many unnecessary days in hauling coal hundreds of unnecessary miles in order to deliver it at places much more accessible to other coal fields, whence coal could be obtained with far less tax on the transportation energies of the country.

In addition to the saving in transportation, the system will provide for the possible retention of something like 5,000,000 tons of coal for the eastern states which heretofore has gone west, all rail. This tonnage can be readily utilized in the east. As an indication of the saving to be effected by the system, it will eliminate the movement of more than 2,000,000 tons of Pocahontas coal to Chicago and other western points over a haul of about 660 miles. Chicago can obtain this tonnage of coal, and under this system must obtain most of it from southern Illinois mines, with an average haul of 312 miles. Allowing for the differences in quality in the two coals there will thus be saved 11,400,000 car-miles or very conservatively figured, 285,000 car-days. This will permit 14 additional round trips of 20 days each from West Virginia mines to zone destinations, permitting an additional production of at least 700,000 tons of Pocahontas coal.

Similar comparisons show that on the movement of 550,000 tons annually from Kanawha districts to Wisconsin points there can be saved about 2,500,000 car-miles with a consequent increased production of some 300,000 tons. On the movement from southeastern Kentucky to Chicago the saving will be about 800,000 car-miles and 50,000 tons in production. The elimination of the Indiana to Iowa movement will save 1,600,000 car-miles and add 100,000 tons in additional production. These are only a few of the instances of transportation saving to be effected by the system.

The restrictions imposed upon the movement of coal by the zone system will make necessary some readjustment in fuel practices in various communities affected by these restrictions. The Fuel Administrator confidently expects the patriotic co-operation of every coal consumer who may be inconvenienced by reason of the use of fuel to which he is not accustomed. The vast purpose to be served by the saving which the system effects will undoubtedly command the support of every user of coal.

Under regulations of the Fuel Administrator, coal of particular quality or characteristics for special purposes, such as by-products, gas, blacksmith and metallurgical coal will be permitted to move by permit beyond the limits imposed by the zone system. Permits will be issued to the individual consumers having need of this special-purpose coal where a supply is not available in their producing districts. Applications for permits must be made to the Zone Permit Bureau of the United States Fuel Administration in Washington. The zone system affects all bituminous coal except

(1) Coal for railroad fuel for which special arrangements will be made by the Fuel Administrator and the Director General of Railroads.

(2) Coal, for movement on inland waterways, which is in no way restricted by the system.

(3) Coal delivered to Canada, which is subject to regulations of the Fuel Administrator.

Heretofore many of the mines in the producing districts throughout the country have been unable to keep up their production in the summer months because of the decreased demand for their products. Under the zone system these producing districts have been allotted consuming territory which will demand a large increase in production. Thus coal which has long been available but not used will be added to the aggregate supply for the country as a whole. Consumers in these zones must fill their bins during the coming summer and keep the mines running every day of the week if these zones are to avoid serious coal shortage next winter.

The early buying of next winter's supply of coal by consumers throughout the country is considered imperative by both the Fuel Administrator and the Director General of Railroads. Ample production capacity has been assigned to each of the consuming zones outlined in the system, but these producing fields must be kept working as nearly as possible at their maximum capacity if the system is to be a success.

The notice sent out some time ago regarding the possible cancellation of all coal contracts made previous to August 23, 1917, has caused considerable anxiety among public utilities and others who have such contracts. This in connection with the zone plan, has made the situation a very serious one, and the Committee has been making every effort to secure definite action and decisions, so that public utilities may know exactly where they stand in connection with their contracts.

The Priorities Committee of the War Industries Board is endeavoring to arrange to furnish sufficient steam and electrical machinery to the several nitrogen fixation plants and powder plants that the Government is erecting. This committee has been called upon in an advisory way to furnish all information possible regarding the delivery to electric light and power plants of turbine units that are now under order at the manufacturers, as it will be asolutely necessary to requisition some of this apparatus for the Government. The Priorities Committee is particularly anxious to interfere as little as possible with the operations of public utilities, and it is in extreme cases only that it will find it necessary to take over machinery ordered by the central stations.

The information that this committee was requested by Dr. Garfield, U. S. Fuel Administrator, to procure as to the names and addresses of isolated plants operating in the territory served by central stations is being tabulated as rapidly as received.

Many communications have been received from electric light companies asking if the Fuel Administration is considering rescinding the lightless nights order. This matter, under consideration with a view to possible modification for the next four months, is being opposed by a majority of the state and local fuel administrators.

ELECTRICAL MANUFACTURERS FORM SIGNALING-APPARATUS SECTION.

Standing Committees Appointed, Officers Elected and Plans for Future Activities Formulated.

The Signaling-Apparatus Section which was recently formed in the Associated Manufacturers of Electrical Supplies, held its second meeting at the Association rooms on Friday, April 5, at 2:30 p. m. George L. Patterson, of Stanley & Patterson, Inc., New York City, is chairman of the Section, with R. Edwards, Jr., of Edwards & Company, Inc., New York City, secretary, and E. Whitmore, of the Manhattan Electrical Supply Company, New York City, treasurer.

The following standing committees were appointed in the Section:

Committee on Annunciators: E. Ward, Wilkins, chairman, Partrick & Wilkins Company, Philadelphia, Pa.; T. W. Ness, Holtzer-Cabot Electric Company, Boston, Mass.; R. Edwards, Jr., Edwards & Company, Inc., New York City.

Committee on Small Bells and Buzzers: W. J. Tonkin, chairman, Ansonia Electric Company, Ansonia, Conn.; C. P. LaShelle, W. R. Ostrander & Company, New York City; E. Whitmore, Manhattan Electrical Supply Company, New York.

Committee on Contact Devices: E. Whitmore, chairman, Manhattan Electrical Supply Company, New York; W. J. Tonkin, Ansonia Electrical Company, Ansonia, Conn.; Albert S. DeVeau, Stanley & Patterson, Inc., New York.

Committee on Fire Alarm Apparatus: Vernon Durbin, chairman, Holtzer-Cabot Electric Company, New York; G. L. Patterson, Stanley & Patterson, Inc., New York; R. Edwards, Jr., Edwards & Company, Inc., New York.

Committee on Signal Gongs: G. L. Patterson, chairman, Stanley & Patterson, Inc., New York; T. W. Ness, Holtzer-Cabot Electric Company, Boston, Mass.; R. Edwards, Jr., Edwards & Company, New York.

Committee on Telephone Apparatus: B. C. Rogers, chairman, Connecticut Telephone & Electric Company, Meriden, Conn.; A. S. DeVeau, Stanley & Patterson, Inc., New York.

Committee on Telegraph Instruments: E. Whitmore, chairman, Manhattan Electrical Supply Company, New York.

Membership Committee: C. P. LaShelle, chairman, W. R. Ostrander & Company, New York; E. Ward Wilkins, Partrick & Wilkins, Philadelphia, Pa.; M. J. McElroy, Holtzer-Cabot Electric Company, New York; B. C. Rogers, Connecticut Telephone & Electric Company, Meriden, Conn.; W. J. Tonkin, Ansonia Electric Company, Ansonia, Conn.

Another meeting will be held at an early date, when the various committees will have their plans formulated for active work along the different lines already suggested and it is felt that this Section will be a very important one in the industry covered.

BILL MERGING COMMISSION PASSED.

The State Senate, Albany, N. Y., recently passed the Thompson Bill combining the two present public service commissions into a single-headed commission of seven members. The new commission will have jurisdiction all over the state, three of the members being hearing commissioners and the other four investigating and regulatory commissioners.

AWARD IN BOSTON STREET-LIGHTING ARBITRATION.

Long Drawn Out Case Settled—Annual Saving of $42,718.70 Secured by City in Ten-Year Contract.

An arbitration that took over three years before its conclusion has finally settled respecting the price to be paid by the city of Boston to the Edison Electric Illuminating Company of Boston for street lighting in that city. The award, resulting in a reduction of the total annual cost from $479,718.70 to $437,000, or a yearly saving of $42,718.70, was made by the Board of Gas and Electric Light Commissioners of Massachusetts.

The contract bears date of December 7, 1914, and provides for street lighting for a period of 10 years. The total number of lamps provided for at the beginning of the contract was 8,650 classified as shown in Table I. Lamps are lighted on an all-night every-night schedule of 3828 hours yearly. The company owns and provides all lamps, fixtures, poles, circuits, etc., except certain posts owned by the city and formerly used for gas lighting; these have been equipped by the company for electric incandescent lighting.

After signing the contract both parties to the agreement jointly requested the Board of Gas and Electric Light Commissioners to investigate and decide whether the prices named in the schedule (see Table II) were fair, taking into account the length of the term, the discount, and other matters pertinent to the question. It was agreed that any reduction in charges awarded by the Board should apply to the full term of the contract beginning December 7, 1914. The company presented a mass of data on the cost of all equipment used directly for street lighting, the proportional part of the cost of other equipment partly used, and the direct and proportionate costs of rendering the street-lighting service.

The award of the Board was to reduce the running costs for lamp-hour as indicated in the last column of Table II, the aggregate result being a reduction of $42,718.70 per year for the number and types of lamps in service at the beginning of the 10-year term and given in Table I.

TABLE I.

No. of Lamps.	Series or Multiple.	Candle-power.	Watts.	Type of Lamp.
4515	Series	800	500	D. C. magnetite arc.
28	Multiple	....	500	D. C. magnetite arc.
24	Series	1600	500	D. C. Thoran arc.
1527	Series	40	...	Incandescent.
781	Series	60	...	Incandescent.
1	Series	100	...	Incandescent.
1393	Multiple	40	...	Incandescent.
376	Multiple	60	...	Incandescent.
10	Multiple	100	...	Incandescent.
2	Multiple	125	...	Incandescent.
3	Multiple	400	...	Incandescent.

TABLE II.

Candle power of lamp.	Type of lamp.	*Scheduled; fixed costs per lamp per year.	*Scheduled; running cost per lamp-hour (cts.)	†Arbitrated; running cost per lamp-hour (cts.)
40	Incandescent	$10.80	0.25	0.18
60	Incandescent	12.00	0.30	0.20
80	Incandescent	14.00	0.40	0.30
100	Incandescent	18.00	0.50	0.40
200	Incandescent	25.00	1.00	....
320	Incandescent	36.00	1.50	....
400	Incandescent	42.00	1.60	....
...	425-watt A. C. arc	36.00	1.50	....
800	500-watt D. C. magnetite arc	36.00	1.60	1.37
1600	500-watt D. C. Thoran arc	42.00	3.20	....

*Subject to following deductions: (1) for outages 1 cent per hour for lamps of 100 c. p. or less, 5 cents per hour for all other lamps; (2) discount of 1 per cent per year for each year up to ten—in this case 10 per cent.

†Applies to series lamps only.

COAL DISTRIBUTION UNDER THE ZONE SYSTEM.

Outline of Plans Put into Effect by the U. S. Fuel Administration.

The United States Fuel Administration, Washingington, D. C., has issued Publication No. 21, outlining and explaining the Zone System for the distribution of bituminous coal. The plan presented was worked out in co-operation with the Director General of the Railroads. The zone system announced governs the distribution of that class of coal for the coal year, beginning April 1, 1918.

The distribution of coal, heretofore, has been carried on without much regard to the distances between the producing mine and the consumer. Under the existing zone arrangement, the distribution is to be carried on under regulations that will avoid, as far as possible, the waste of transportation energy, but which will be consistent with the maintenance of the maximum production and adequate supply to all users. The plan is that consumers in a designated zone are to be supplied from the most accessible coal fields, thus, economizing advantageously as possible in the use of cars and engines, as well as in fuel for haulage. In carrying out the plan the patriotic co-operation of all concerned is asked for. It is not presumed, therefore, that a customer will insist upon receiving his favorite grade of coal from a distance when there is a supply nearer by that will serve his purpose. For instance, instead of moving 2,000,000 tons of Pocahontas coal 660 miles to Chicago, the supply, under the zone regulation, must come from Southern Illinois, requiring a haulage of 312 miles. It is figured that in this item alone there will be a saving of 11,400,000 car-miles. Other illustrations of similar import are given, showing savings in transportation energy, surprising in magnitude.

Mining fields, each being allotted certain designated territories, will be able to figure closely on the probable demands for their product; and the arrangement makes it incumbent upon the consumer to lay in supplies in summer, thereby equalizing the summer and winter demands, and preventing a shortage during the latter season.

The entire country is divided, for this purpose, into 13 zones, the source of coal supply being designated for each zone; the railroads charged with the distribution of coal to each zone are also specified. The entire plan is admirably worked out and is of the utmost importance to mine operators, railroad managers, and all coal consumers.

NEW YORK'S ELECTRICAL FIRES.

Of the 14,053 fires occurring in New York during 1917, only 152 were attributable to defective electrical installations. The total property loss caused by these fires, as shown by the annual report of the Committee on Electricity of The New York Board of Fire Underwriters was less than fifty thousand dollars—$47,496.29, to be exact.

During 1916, the loss from electrical fires was $91,549.00, and for 1915, the loss was $68,993.08. Of these amounts, however, a considerable part was due to fires in installations which had not been approved by the Board.

To determine the causes of all fires occurring in this city, and knowing the cause, seek to prevent their repetition, is one of the functions of the Board of Fire Underwriters. Through different committees it investigates every blaze, its Committee on Electricity specializing on fires thought to be of electrical origin.

Of the 1917 loss, $33,428.42 is directly chargeable to new electric equipments or additions or extensions made to original equipments without the knowledge or approval of Board. Of the 1916 loss, $73,750.00 is thus classified, and of loss in 1915, $40,433.43 is so charged. Thus for the three years the losses in installations which were supposed to be in a safe and satisfactory condition were $28,559.65 in 1915, $17,999.00 in 1916, and only $14,067.87 last year.

The Underwriters reference to equipments and installations made without their knowledge gains an added significance in the light of a household hint published recently in a woman's paper, says the Edison Monthly in its April issue, in which are given careful directions for the removal of electric fixtures, the installation of new fixtures and the running of wires, conceaed by the baseboard or picture molding, to all parts of the room. It's all very simple according to this paragraph, but—it's the work of such amateur electricians that means the difference between, as was the cast last year, a loss of $33,000.00 in unauthorized installations, and a loss of but $14,000.00 in installations which were supposed to be in good order.

BETHLEHEM STEEL WILL OPERATE CHILEAN IRON MINES.

Power Plant at Cruz Grande, and Electric Railway to Tofo Mines.

The iron ore deposits of Tofo Mountain, Chile, situated 14 miles from the port of Cruz Grande, are being opened by the Bethlehem Chile Iron Mines Company, which has a 90-year lease on the property. The deposit is said to contain 100,000,000 tons of ore running 68 per cent iron. The locality is a barren region, where the port was hewn out of the solid rock, to make a shipping point for this vast tonnage of iron ore. The docks at the port are being connected with the Tofo mines by a standard-gauge electric railroad, 14 miles in length. In that distance the line makes an ascent of 2600 feet, the grade being reduced to a maximum of 3 per cent by a number of loops and zigzags. Three electric locomotives to be used are similar to those employed by the Chicago, Milwaukee & St. Paul Railway Company on its Rocky Mountain Division in Montana. Plans provide for the regenerative system of braking whereby a down-grade loaded train will develop current that may assist in hauling an up-bound empty. The train schedules are to be so arranged that this will be possible.

The ore cars will be all steel, hopper-bottomed, and having 50 tons capacity and with air valves for opening and closing the hoppers. The generating station, from which electric power will be supplied for the railroad, has been completed. It is situated at the docks and is a steam-driven plant in which oil is used as fuel.

These mines, formerly operated, had been idle a number of years, when in 1913 they were acquired by the company above named as lessee. The company may operate on a large scale as soon as transportation matters are satisfactorily arranged. The deposits are exposed and no stripping is required and no shafts need be sunk. The ore, when blasted, will be loaded into cars by electric cranes and hauled a short distance to a crushing plant, in which it will be reduced to a maximum of 4-inch size for transportation to the port, to be shipped thence to the United States.

BUSINESS MEN URGE WATER-POWER LEGISLATION.

Chamber of Commerce Adopts Resolutions Calling on Congress to Make Provision for Utilizing the Country's Millions of Water Horsepower.

By sweeping majorities 500,000 business executives who comprise the membership of the United States Chamber of Commerce on March 27 adopted resolutions calling on Congress to make provision for harnessing the millions in water horsepower that now run wild.

The vote was taken through the more than 1000 commercial organizations throughout the country which compose the National Chamber. Forty-five states, Alaska and Hawaii participated in the balloting, representing a wide range of industrial interests and opinions and reliably indicating to Congress how the business men of the nation look on the water power situation. Each voting organization cast from one to ten votes, depending on its membership.

The balloting was based on a series of recommendations contained in the report of the Committee on Water-Power Development of the U. S. Chamber of Commerce. These recommendations were presented in the following order:

(1) That federal legislation encouraging the development of water powers should at once be enacted. Adopted by the almost unanimous vote of 1324 to 6.

(2) That authority to grant permits should be vested in an administrative department. Carried by a vote of 1253 to 17.

(3) That the permit period should be at least 50 years, any shorter period being at the applicant's option. In favor 1216, opposed 42.

(4) That tolls should attach only to use of public lands or benefits derived from head-water improvements. Adopted by vote of 1191½ to 40½.

(5) That permittees should be entitled to acquire the right to use public lands forming only a small and incidental part of the development. Carried by a vote of 1210 to 25.

(6) That recapture should be exercised only upon payment of fair and just compensation. In favor 1234, opposed 25.

(7) That if recapture is not exercised, the investment of the permittee should be adequately protected. Adopted by vote of 1226 to 26.

(8) That rates and service should be regulated by state commissions where the service is intrastate, with federal regulation only where several states are directly concerned and do not agree, or there is no state commission. Carried by a vote of 1177 to 57.

(9) That if any jurisdiction to regulate the issuance of securities is exercised it should be solely by the state. In favor 1114, opposed 117.

(10) That no preference should be granted as between applicants amounting to a subsidy from the government creating unequal competition. Adopted by a vote of 1191 to 38.

The Committee which drew up the report and presented the resolutions was composed as follows:

L. S. Gillette, chairman, engineer and manufacturer, Minneapolis; Harry A. Black, wholesale merchant, Galveston; Rome G. Brown, lawyer, Minneapolis; Henry S. Drinker, president, Lehigh University; Frank P. Glass, editor-in-chief, *Birmingham News*; E. K. Hall, lawyer, New York City; Horace C. Henry, retired railway contractor, Seattle; Henry L. McCune, lawyer, Kansas City.

While the Committee's report is in itself favorable to positive legislation to enlarge water-power development, every ballot sent out was accompanied by an argument in the negative which clearly and positively set forth objections to the recommendations so that those voting had at hand data on which to base their judgment for or against.

The report begins by pointing out that it is estimated that the undeveloped water power of the country exceeds the total steam power now in service. The federal government controls much of the water-power resources of the country.

The report continues: "One of the first things to be clearly perceived is that water-power developments are not exceedingly profitable undertakings earnestly sought by capital as a means of securing large returns on a small investment; but that, on the contrary, steam power is the superior of water power in almost all respects.

"The initial cost of a steam plant is in general but one-half to one-fifth that of a water-power plant of equal capacity. Moreover, a steam plant can be more easily enlarged from time to time and the initial development of a water-power plant must be a larger proportion of the ultimate development than that of a steam plant. The investor in a water-power plant is therefore burdened from the very start with a heavy fixed charge, the failure to meet which may mean bankruptcy.

"Water powers will not be developed unless the conditions are made comparatively favorable. Present demand for the development of such power comes, not from capitalists, but from communities which, on account of the high price and scarcity of fuel, are desirous in their own interest of inducing capital to make such developments."

There are many collateral advantages resulting from the development of water power which are reaped by the community as a whole rather than by the investor. These advantages are the saving of coal and oil, which are exhaustible natural resources and once used, can never be replaced, the saving of railroad equipment needed for their transportation, the saving of labor in coal mines and of railroad labor and labor in distribution.

If the water power now commercially capable of development could be brought into use, the savings to the public in the conservation of fuel and the release of labor and railroad equipment would run into hundreds of millions of dollars annually.

At the present moment the public has been made to realize, as never before, the importance of conserving fuel and labor, and the present emergency accentuates the public need of the formulation of a wise and fair water-power policy by the federal government.

In order to secure the adequate development of water power, it is essential that the subject should be approached with an attitude of mind which recognizes the necessity of making such developments attractive to capital, rather than with that attitude which assumes that such enterprises should be surrounded with as many restrictions as possible.

The conservation of every other natural resource means restriction in its use, for use means consumption and permanent destruction. Every pound of coal burned is forever withdrawn from use. On the other hand, every horsepower of water power not used is lost, and every horsepower conserved and used saves not only the horsepower, but its equivalent in coal and may incidentally improve navigation.

Commercial

Spokane Street Lighting Contracts—Electrical Appliances Effect Fuel Saving—Industrial Heating Device Aided

SPOKANE CONTRACTS FOR ECONOMICAL STREET LIGHTING.

The city of Spokane, Wash., has entered into a 10-year street-lighting contract with the Washington Water Power Company, whereby it effects considerable saving in the cost of street lighting and secures a much more up-to-date and efficient system. The contract provides for the replacement (before January 1, 1919) of about 1400 old carbon arc lamps now in use with the latest gas-filled tungsten lamps at no extra cost to the city. The operating cost of the new lights will be $37 each per year, a reduction of $11 per light per year, from the present rate. This is said to be 25 per cent lower than is charged to the city of Seattle, Wash., by its own municipal plant. The saving in Spokane from the present price of $4 per month per lamp amounts to over $15,000 per year at the present time and, with the addition of new lights during the contract term, will probably make a saving of close to $200,000 during the 10 years. It is provided in the new contract that the agreement may be terminated at any time by giving one year's notice, in the event that the city may wish to operate its own lighting plant. It is also provided that the company may replace the tungsten lamps with new and better ones, at its own expense.

INDIRECT LIGHTING OF A CHURCH AUDITORIUM.

An excellent installation of the indirect lighting of a church auditorium is shown in the accompanying

Shadowless Lighting in Westminster Presbyterian Church, Dubuque, Iowa. Installation by the Keller Electric Company.

illustration. The installation was made by the Keller Electric Company, Dubuque, Iowa, in the Westminster Presbyterian Church, that city. It consists of three X-Ray units, having three 500-watt lamps to each unit, thereby securing even and shadowless illumination.

ELECTRICAL APPLIANCES WILL HELP WIN THE WAR.

Arguments in Favor of Use of Ranges and Appliances and Data on Saving in Coal Effected by Their Use.

By H. V. Coffy.

Arguments seemingly without limit have been advanced by manufacturers, dealers and central stations to show housewives the advantages of electrical appliances, but it has taken the war to bring out the most important reasons of all.

Of great importance to the nation—and consequently to every one in it—is the fact that electrical appliances utilize energy which is generated by a grade of coal or other fuel which is unsuitable for domestic use.

Next in importance is the actual "per pound" saving in coal by the use of electric cooking appliances as compared with the coal used direct for the same purposes.

Third, is the time and labor saved for patriotic duties by housewives who make proper use of electric time and labor savers.

Regarding the first reason for using electrical appliances—there is no argument about its economics. With the exception of central stations using natural gas for making steam to generate electricity, every central station utilizes some grade of fuel which is unsuitable for domestic or residential use. The companies employing coal for fuel use a grade of coal which no housewife would want to use on account of the dirt, even if it could be used satisfactorily otherwise. Other companies use crude oil; some slab wood; and there are several other variants, but none is of value for residential purposes.

Another economic phase of the situation is the transportation problem. Shortage of cars and transportation difficulties caused the recent acute coal shortage. Comparatively few districts are without some local fuel resource, such as wood, oil or soft coal, or are within comparatively short rail distance of such resources. Such local fuel resources are invariably those employed by local central stations, whereas the average householder who heats and cooks with coal is dependent upon fuel mined hundreds of miles away. It therefore follows that every householder who is converted to the use of electrical appliances for cooking is not only protecting himself but he is actually helping to save the Nation's fuel, and he is also helping materially in reducing the tax on the transportation facilities which are needed now for the primary functions of war.

Where central stations are fortunate enough to receive their energy from water powers there is either a surplus of energy available or the company depends upon a steam reserve for surplus demands. In the

first case, increased demands for electricity by the householder do not require coal for fulfillment. In the latter case the same fuel economics apply as with the central station depending wholly upon steam power.

Figures on Saving in Coal.

The second reason for the use of electrical appliances, namely, the actual per pound saving of coal by their use, seems to offer ground for debate. Comparatively few tests have been made for the purpose of proving this point, but those which have been made seem rather conclusive. A certain manufacturer of electrical ranges has made a careful test of this matter and finds that 262.7 pounds of coal used to generate electricity for an electric range will perform the same cooking service as 800 pounds of coal used direct on a coal range. This looks like a very startling statement when it is taken into consideration that engineers point out that only a fraction of the energy value of coal reaches the customer's meter. Analyzed, however, it does not appear so startling.

It speaks for the superior efficiency of electric cooking—the non-waste of energy—more than anything which could be mentioned. It shows that the manufacturer of electric ranges has found means of utilizing almost the last ounce of energy which reaches the customer's meter. It shows conclusively also what we have always known, that solid fuel stoves lose a great deal of energy up the chimney, in uselessly heating the atmosphere, in ashes which contain a large amount of unburned fuel or coal. Recent tests, in fact, made by the State College of Washington, show that the average cooking efficiency of the coal range is only between 2 and 3 per cent.

The figures quoted can be easily substantiated. A family of five will consume an average of 6 tons of coal per year in a coal range. An average of 1200-kilowatt-hours would be used by the same family if cooking on an electric range. Twelve hundred kilowatt-hours of energy would be manufactured by the average coal using central station with 3600 pounds of coal, a clear saving of 2.4 tons of coal to the Nation.

To illustrate the point again—the 3600 pounds of coal used by the central station to meet the customer's requirements would be a cheap grade of soft coal, saving 6 tons of the country's richest and best grade of anthracite which would have required freight car transportation many miles more than was required to transport the soft coal used by the central station.

Incidentally it is of interest to note that the 1200 kilowatt-hours of electricity would cost the customer $48, taking a rate of 4 cents per kilowatt-hour as the average central-station charge for cooking purposes. Six tons of hard coal at $11 per ton, the present charge for hard coal, would cost the customer $66. The customer has therefore made an actual saving of $17 annually by using electricity, to say nothing of the labor saved and the cleanliness and superior conveniences.

Appliances Release Labor of Women.

With all our vast requirements of coal the thing we need most of all is time—time to make up for our lack of preparedness—and if any organization requires the time and labor of men and women nowadays it is the Red Cross.

Electrical appliances admittedly help women to do their housework better and to save time. Several appliances in a household will save several hours of work a week. Several hours employed by one person in each home per week in patriotic service would mean a tremendous advance in the great cause.

One middle western company, serving a population of around 100,000, added 2754 electrical appliances to its line in 1917. This company always enjoyed a good appliance business but 1917 was its record year. Another company, serving a population of 300,000, added to its lines 22,373 household devices in 1917. Doubtless 1918 will make the 1917 figures for both of these companies seem small by comparison.

Without fear of contradiction the central-station salesman can make the statement that electrical appliances are helping to win the war and show figures to prove it.

BETTER CO-OPERATION BETWEEN CENTRAL STATIONS AND CONTRACTOR-DEALERS IS DESIRED.

A plea for better co-operation between the central stations and the electrical contractor-dealers was the principal purpose of an address by L. K. Burch, Madison, Wis., at the annual convention of the Wisconsin Electrical Association, at Milwaukee, in March. He pointed out how conditions in the electrical industry may be improved by a better understanding between the two, and asserted the willingness of the contractors and dealers to act in harmony with the central stations in standardizing work and prices.

Speaking of the National Association of Electrical Contractors and Dealers, he says:

"As we stand to-day, we are an association covering 25 states of the Union and feel that a better condition should exist between the central station and contractor-dealer. The contractor-dealer, who has put from 8 to 20 years in the business, feels that it is time to graduate into a real merchant. He feels that he should be able to place himself and his electrical business before the eyes of the public in such a manner as will excite only favorable comment and appreciation.

"Would it not be well for the central-station manager in his town to call a meeting of the contractor-dealers and give them talks on the merchandising of electrical goods, and for the treasurer to give them a talk on credits and investments, showing them how much more goods they can carry if they would confide with the bank cashier and help him to build up his business by the establishment of better confidence."

AN INCREASED POWER LOAD AT DUBUQUE.

The Dubuque Electric Company, Dubuque, Iowa, has materially increased its power load since January 1, as is indicated by the following new contracts for power in numerous plants. It is interesting to note the number of electrical installations which are replacing steam power in old, established shops and factories.

The A. Y. McDonald Manufacturing Company, makers of plumbing supplies, recently installed 40 motors to operate its machinery, and will require 370 horsepower in energy from the central station. This installation supplants steam power.

The Dubuque Mattress Company has installed 69 horsepower in motors for operating excelsior machines, wool carders, pickers, renovators and other equipment.

The Metz Manufacturing Company, operating a woodworking shop, is changing partly from steam to electric power, for which a 40-horsepower motor is insalled to drive a double surfacing machine, which in turn is direct-connected thereto by flexible leather coupling.

HELPING THE INDUSTRIAL ELECTRIC HEATING DEVICE.

The Commonwealth Edison Company Employs Many and Divers Ways of Placing the Electric Heating Device.

The domestic and industrial electric heating devices are one form of load that will improve the load curve, add to the revenue and still permit a central-station company to conserve its efforts and capital as war-time conditions require.

In Chicago, for many a day, both the industrial and commercial electric heating device has been encouraged and pushed, with good results. The Commonwealth Edison Company employs the mails very largely in spreading the propaganda of the electric heating device. Separate folders, of which two are shown, power and light bills, are playing there part in bringing before customers, plant managers and the public alike the value of the electric heating device in factory and home, in fact everywhere. But this is not all, for the industrial heating division of the contract department makes personal investigations of industrial and commercial plants where electric heating devices might be used, and often design appliances especially for the work they are to do. The right appliance in the right place, and the best at that is the creed.

Domestic heating devices such as the flat iron, the hair curler, the toaster, broiler, the coffer percolator and many more—they are good sellers, and are well known. But there is a horde of industrial or commercial heating devices, each of considerable importance and that will use kilowatts where the domestic appliances will use watts.

The Seven Steps in Baking

THE sun and a flat rock were the only requisites for baking in the days of the Cavemen.

The intuition of prehistoric man caused him to obtain fire, but gradually this fear was overcome by more thorough knowledge and civilization.

In the relics of ancient Egypt, remains of cooking utensils are mute evidence of wondrous cookery mentioned in the archives of that bygone age. The banquet hall of an old English baron, with its roasting spit and wood fire, allowed another side in the art of baking. The open fireplace, with the Dutch oven, was a familiar sight in our own country during the Colonial days.

Another stride forward came with the introduction of coal as fuel, ovens could then be more evenly heated and economically operated. The gas oven is one of the more modern inventions that partially eliminates the soot and smoke formerly caused by coal combustion. On top of the progress in cooking, stands the electric oven. The experience, with other forms of fuel, has created a demand for a means of heat that gives off no flames, soot, or smoke, and electricity meets those requirements.

Electricity—The Efficient Industrial Heat

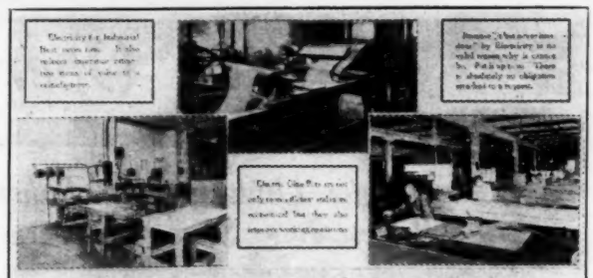
Heat without flame—heat that can be regulated to any desired temperature—heat that can be applied without waste to meet the requirements of any industrial purpose—is only attained through the use of electricity. Better working conditions result when electricity is used for industrial heat. There is no need for an elaborate system of piping or any complicated apparatus in connection with electric heat. It is the simplest and most efficient form of heat for industrial purposes.

Expert Engineering Service Without Charge

There are many forms in which electricity may be applied as a source of industrial heat. In every branch of manufacturing where heat is used, this work may be done by electricity. Engineers who have specialized on electric heat will co-operate with you to produce satisfactory results. If there is no appliance made to suit your particular need, our engineers will design one. In Chicago there are many successful installations of electric heat. Let us tell you what it can do for you. Just mail the "no obligation" card now.

COMMONWEALTH EDISON COMPANY
INDUSTRIAL HEATING DIVISION—CONTRACT DEPARTMENT
Edison Building 72 West Adams Street Chicago, Illinois

Fig. 1.—A Form of Advertising That Draws the Interest for the Truth and the Eloquent Lesson It Teaches. Then Comes a Trial—a Satisfied Customer, and a Champion of the Electric Heating Device.



THE W. C. RITCHIE COMPANY, one of the largest manufacturers of paper boxes in the United States, use electrically heated glue pots. This installation replaced the use of cold glue; the speed of each operator was increased and better working conditions are the result.

¶ SPRAGUE, WARNER & COMPANY have the above illustrated installation of gluing machines. This installation shows an actual saving, part of which is insurance. The reduction of this item is always desirable, not alone for the saving, but for the bettering of conditions which it indicates.

¶ THE PATENT VULCANITE COMPANY make roofing paper. As this material has to be made in endless strips, it was formerly necessary to delay five to seven minutes of each half-hour for this purpose. With the electric installation illustrated NO TIME WHATEVER IS LOST.

¶ We can refer you to several other successful applications of Electricity for Industrial Heating.

¶ Just ask us to SHOW YOU what it will do for YOU.

¶ Before you misplace the enclosed card, sign it and send it back. You will be under no obligations whatever.

Commonwealth Edison Company
Heating and Appliance Division
Edison Building CHICAGO Adams and Clark Streets

Fig. 2.—Telling What Some Are Doing Enables Others to Do Likewise. And There Is Room for All With the Electric Heating Device.

The field of the industrial heating devices has been well covered in Chicago already. No opportunity is missed. No circumstance or condition where electric heating can be used is allowed to go untried. Still plenty remains to be done, however, in a field so wide, and so varied, ranging from the hospital with its sterilizers and cauterizing needles to the glue pot in the mailing room of the mail-order house or the heater in the hat factory. The Society for Electrical Development, in its booklet entitled "More Than 3000 Uses for Electricity" gives instances galore of the use of heating devices, and should open the eyes of the electric device salesman who has not already seriously catered to the large market for commercial heating appliances.

It is not difficult to interest a prospective user of the electric heating device. Accurate heat control, minimum floor space, concentration of heat, absence of noxious odors and fumes, uniform temperature, large reduction of fire hazards, elimination of lost motion and lost time, since each worker can have his or her own heater, healthier working conditions and pleasanter surroundings, better work, since the air need not be contaminated by smoke and flame and gas, nor air kept stagnant because of fear of a naked flame—these are some of the factors that make a ready listener of a prospective user, and a satisfied customer after he has used them.

The industrial electric heating device represents not only a greater revenue producer than the domestic heating device, but it at the same time has higher load factor, and the Commonwealth Edison Company is boosting both the domestic and the industrial heating device. In the next issue of the ELECTRICAL REVIEW the effect of this company's publicity and educational work will be more fully dealt with.

Operating

Unique Underground Substation—Coal Storage Data—Boiler Log Sheet—Street Lighting Schedules for May

A UNIQUELY SITUATED UNDERGROUND SUBSTATION.

Dewey Square Station of Boston Elevated Railway Situated Between Subway and Surface Interesting Example of Compact Arrangement of Equipment.

The Dewey Square Station of the Boston Elevated Railway Company, not long since placed in service, is rather uniquely situated. It is located between the surface of the street and the subway beneath, which is operated by the Boston Elevated Railway, the walls of the station forming part of the subway station. Although in an out-of-the-way place where space is cramped, the station has a most important function to perform, for it is located near the entrance to South Station, the terminal of the New York, New Haven & Hartford, and the Boston & Albany Railroads. This location is the center of an extremely dense traffic movement on account of the close proximity of the business district and the thousands of passengers entering and leaving the city every day.

Until a few years ago, the supply for the entire traction system of Boston was direct current, and it was then decided to change over to alternating current and make the change gradually, and this is now being accomplished at the rate of approximately one substation each year. In the year 1911, approximately 40 per cent of the equipment was changed. When the time came to locate the substation to feed this populous territory where real estate is naturally very high priced, a happy solution was afforded when the Rapid

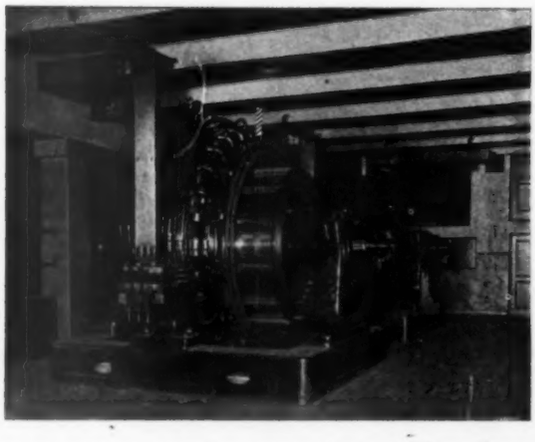


Fig. 1.—Rotary Converters and Air-Blast Transformers.

Transit Commissioners built the South Station depot of the subway. It was then decided to locate the substation in the space between the subway tracks and the surface, a space that otherwise would have had to be filled in, and it was really more economical to build a station than to make the fill. Accordingly, a station having a floor space of approximately 83 by 56 feet with a height of approximately 16 feet was erected in this space.

As may be seen from Fig. 1, the apparatus is very compactly arranged. There is, however, ample room for three 3000-k. w. synchronous converters which is the ultimate capacity of the station. Only two of the three synchronous converters have been installed so far, space being reserved for the additional unit.

The installation of the apparatus was greatly facilitated by loading it on flat cars and bringing it in on the subway tracks to a point under the station, and lifting it up by the crane through openings provided in the station floor.

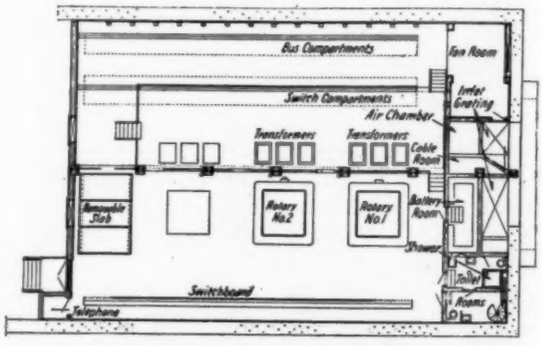


Fig. 2.—Floor Plan of Substation.

Three high-tension lines enter the station, two of them being used as feeders for the supply circuit, same being three-phase, 25-cycle, 132,000 volts.

The third line is used for feeding out from the station. There are two sets of three 1050-k. w. Westinghouse air-blast transformers by which the high-tension current is stepped down to a voltage of 452 for the rotaries. The conversion from alternating current to direct current is effected by two 3000-k. w., 25-cycle, 600-volt, 350-rpm., six-phase, Westinghouse synchronous converters.

The incoming and outgoing lines are controlled by a 33-panel slate switchboard mounted on the same floor with the converters. The oil circuit-breakers for the control of the high-tension circuits are located immediately at the rear of the transformers on the same floor level, and are controlled from the panel board which is equipped with the usual complement of meters, switches and relays.

There are 19 direct-current feeders in use at the present time, but eventually about 30 feeders will be required to take care of the rapidly growing load carried from this station. A watt-hour meter is installed on each outgoing feeder to the Rapid Transit system, primarily for the purpose of facilitating the work of the accounting department in charging each division with the amount of energy used by it.

The negative terminal of the rotary is connected

directly to the cable room by means of a copper bus bar.

The oil switches are operated by current from a 120-ampere-hour storage battery located in an unusually well lighted and ventilated room.

The question of ventilation, always an important one, was successfully solved by taking air from the subway, which is especially well ventilated, and forcing it by blower through the air-blast transformers out into the station. By this means an ample change of air is obtained for the substation, at the same time assuring good ventilation for the transformers.

The comfort of the employees is added to very materially by the provision of lockers and shower baths conveniently located.

The station has now been in operation for several months, carrying the load in this district, though in cases of emergency it can be shut down and the load thrown onto the other stations, the old copper installed for the direct-current distribution system still being in service.

FACTS AND FIGURES ON STORING COAL.

Costs, Effects and Precautions for Safeguarding the Storage of Bituminous Coal.

When it is remembered that the demand for coal varies with the weather and industrial activity, that the railroads have considerably lessened ability to transport freight in winter when the demand for coal is greatest than during the summer months when the demand for coal is at its minimum, and that at best the mines of the United States operate only about 200 days per annum, it is realized that the storage of coal would do much toward equalizing production and costs, relieve suffering and congestion by reducing the peak demand and tending toward more uniform production to the betterment of miner, dealer, transportation concerns and consumer.

While anthracite has and is being stored on a large scale the characteristics of bituminous coal have in the past been thought to have prevented it from being stored on the same scale that has anthracite. In a paper entitled "The Storage of Bituminous Coal," read before the Western Society of Engineers on April 15, H. H. Stoek, professor of mining, University of Illinois, presented a number of important facts about storing bituminous coal. After discussing some of the economic and sociologic influences of coal storage, Prof. Stoek went on to cover the practicability of coal storage from the viewpoints of deterioration of the coal, spontaneous combustion, influence of size of coal, size and shape of coal pile and the ventilation of the latter.

The choice of a storage system embraces the following: location, size, and topography of the available storage ground, capacity of desired installation, or amount of coal that can be loaded and unloaded in a given time, cost of necessary plant, cost of maintenance, cost of operation, amount of breakage due to handling the coal, manner of receiving coal, length of time of keeping coal in storage, and climate. After describing the various methods of storing coal, namely, hand storage, storage by motor truck, trestle, side-hill, mast and gaff and locomotive storage and use of side dump cars, circular, steeple, and bridge storage, a quantity of cost data was given for the various methods of storing coal.

Costs for storing coal may be considered under the following heads: overhead, labor, supplies, depreciation on mechanical equipment, interest on investment, rental on land used for storing coal, insurance on equipment, insurance on coal. Each of these should, moreover, be divided between the items for storing and reclaiming. The following costs have been collected from various companies storing coal. All costs are not on the same basis, nor of the same degree of completeness; practically all costs given are per ton. However, they give some idea of what may be expected:

HAND STORAGE.

	Storing.	Reclaiming.	Total.
Bohmer Coal Co., St. Louis, stored on ground and reclaimed by hand shoveling	...	...	$0.15-.30
St. Bernard Mining Co., Nashville, Tenn., dumped from wagons; reclaimed directly into wagons	$0.22	...	...
Polar Wave Ice & Fuel Co., St. Louis, hand labor	.48	$0.16	.64
Crystal Ice & Fuel Co., Danville, Ill., stored in bins by dumping; reclaimed by shoveling	...	...	.17
Ebner Ice & Cold Storage Co., Vincennes, Ind., by hand labor and conveyors	$0.154	...	...
For depreciation and interest also under water	.214	...	.368
Rock Island Fuel Co., Rock Island, Ill., labor only	.08	.10	.18
Univ. of Ill. motor truck and hand	...	...	.21-.34
Side-hill storage, estimated in 1917			

LOCOMOTIVE CRANE.

Estimated cost of operating locomotive crane, $1.50 per hour, or 3c per ton			
A large wholesale and retail coal company	.015	.02	.095*
Commonwealth Edison Co., Chicago, labor and materials only	.05	.05	.10
Clinchfield Fuel Co., Dante, Va., crane and trestle	.0671	.0655	.1326
A large wholesale and retail company	...	...	.04-.20
Pittsburgh Plate Glass Co., Crystal City, Mo.	.25	.25	.50
Rockford Electric Co., Rockford, Ill.	.10	.10	.20
American Zinc Co., E. St. Louis, Ill.	.20	.15	.35
Mineral Point Zinc Co., Depue, Ill.	.05-.06	.05-.06	.10-.12
Crerar-Clinch & Co., Chicago, hand and locomotive crane	...	...	.25
Estimate by C. G. Hall	...	...	.2628
Mo., Kan. & Texas Ry., including cost of track	.035	.035	.07
Chicago, Lake Shore & S. Bend Ry.	...	...	.12
Grand Trunk Pacific Ry.	.08	.062	.142
Atlantic Coast Line	...	...	.04-.05
Central of Georgia Railroad	.0258	.0209	.0467

*This total includes $0.04 for interest and $0.02 for depreciation.

STEAM SHOVEL.

Union Light & Power Co., of St. Louis, dumped by hand; reloaded by steam shovel	.10	.10	.20

BRIDGE STORAGE.

Wisconsin Gas & Electric Co., Racine, Wis.	.08	.22	.30
Berwind Fuel Co., Duluth, Minn.	...	...	.60
Link-Belt Co., estimate for bridge storage	.056	.0515	.1075
Calumet & Hecla Mining Co., Calumet, Mich., Hunt system, steam shovel, Summer	.15	.07½	.22½
Winter	.15	.11¼	.26¼
Large swivel bridge	...	.06	...

UNDER-WATER STORAGE.

New Kentucky Coal Co., Kankakee, Ill., storage of 250,000 tons	20,000-30,000		...
Metropolitan Water Dist., Omaha, Neb.	.063	.063	.126
C. G. Hall Estimate	...	...	.1523
Peabody Coal Co., Lemont, Ill., estimated cost of operation	...	...	.162
Estimated cost of equipment	13,830	...	...
Western Electric Co., Chicago	.05	.04	.09
National Zinc Co., Springfield, Ill., 1913	...	...	.225
1917	.10	.10	.20

MINERAL POINT COMPANY BUILDS TRANSMISSION LINE.

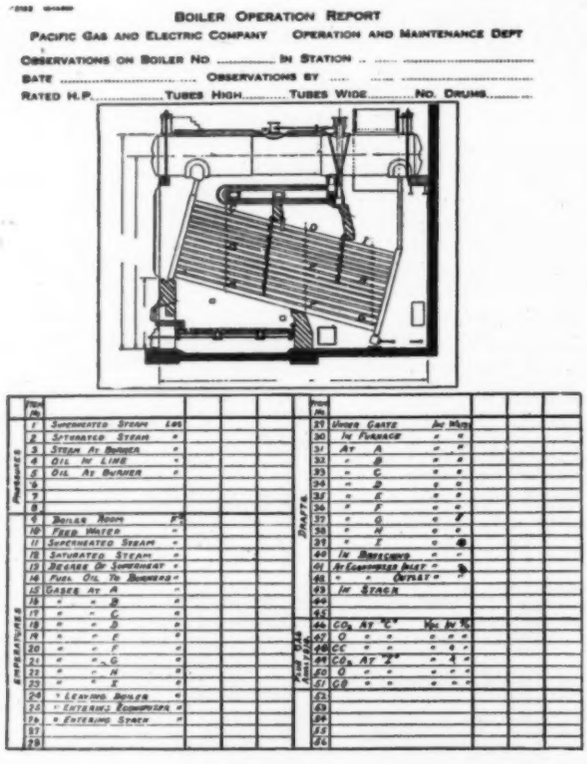
Mineral Point Public Service Company, Mineral Point, Wis., is building 14 miles of 33,000-volt transmission line to connect its system with that of Interstate Light & Power Company at Plattsville. Most of the material is on the ground and the work is going on.

A BOILER LOG SHEET FOR OIL-FIRED BOILERS.

Form of Log Sheet Employed by Pacific Gas & Electric Company for Recording Combustion and Boiler Performance.

Fuel oil is used very largely on the Pacific Coast for fuel purposes in the absence of coal. The central-station companies use oil almost exclusively for their stand by stations operating in parallel with hydroelectric plants. Since the war oil has assumed greater importance than previously, because the demand has increased at a more rapid rate than the production. Higher oil prices and greater difficulties in obtaining quantities necessitate conservation by efficient utilization.

The accompanying illustration shows the form of boiler operation report employed by the Pacific Gas & Electric Company for recording boiler performance.



BOILER OPERATION REPORT

PACIFIC GAS AND ELECTRIC COMPANY OPERATION AND MAINTENANCE DEPT

OBSERVATIONS ON BOILER NO ..... IN STATION .. ..

DATE ..... OBSERVATIONS BY .....

RATED H.P. ..... TUBES HIGH ..... TUBES WIDE ..... NO. DRUMS .....

Pressures	No.						Drafts	No.					
	1	Superheated Steam Line						29	Under Grate	In Water			
	2	Saturated Steam "						30	In Furnace " "				
	3	Steam At Burner "						31	At A " "				
	4	Oil In Line "						32	" B " "				
	5	Oil At Burner "						33	" C " "				
	6							34	" D " "				
	7							35	" E " "				
	8							36	" F " "				
Temperatures	9	Boiler Room F°						37	" G " "				
	10	Feed Water "						38	" H " "				
	11	Superheated Steam "						39	" I " "				
	12	Saturated Steam "						40	In Breeching " "				
	13	Degree Of Superheat "						41	At Economizer Inlet "				
	14	Fuel Oil To Burners "						42	" " Outlet "				
	15	Gases At A "						43	In Stack				
	16	" " B "						44					
	17	" " C "						45					
	18	" " D "						46	CO_2 At "A" Vol. In %				
	19	" " E "						47	O " " " "				
	20	" " F "						48	CC " " " "				
	21	" " G "						49	CO_2 At "B" " "				
	22	" " H "						50	O " " " "				
	23	" " I "						51	CO " " " "				
	24	" Leaving Boiler "						52					
	25	" Entering Economizer "						53					
	26	" Entering Stack "						54					
	27							55					
	28							56					

Log Sheet Employed by Pacific Gas & Electric Company for Recording Performance of Oil-fired Boilers.

This log shows at once the performance of a boiler, thus affording valuable data as to evaporation of various units from time to time. It will be noticed that this log contains practically all the information necessary in determining combustion and boiler performance, for indicating air infiltration by recording the percentage of carbon dioxide at the first and last passes. Determinations for oxygen and carbon monoxide are also made, giving immediate data on combustion efficiency.

The condition of the passes, breechings and other gas passages can be watched by recording the draft or pressure of water column, also the performance of damper control. The condition of the baffles, settings, heating surfaces and air infiltration can be determined with considerable accuracy from the temperature readings taken at various positions in the gas passages. All these determinations are recorded on the forms shown and filed. In this way performance from time to time may be compared and discrepancies and shortcomings, if they occur, may have a reason found and quickly remedied.

The log sheet shown is for use during normal operation and not for special evaporation tests, the log sheet for which should include records giving the amount of oil consumed, amount of steam required for atomization, and amount of water evaporated.

The Pacific Gas & Electric Company operates the largest system of oil-fired steam power plants in the world, hence the company appreciates the necessity of maintaining high combustion efficiencies and over-all efficiency of its boiler rooms. But even so, since the war, this company has done everything possible to use water power instead of steam by interconnection and other economies.

Street Lighting Schedules for May.

Every plant operating street lighting circuits must have a definite schedule for lighting and extinguishing the lamps. Below are given the two most commonly used schedules as compiled for next month. The table is compiled for latitude 40° north. Since throughout May the "day-light saving" plan of having all clocks set one hour ahead of standard time will be followed, the time given in the table (instead of being mean local or solar time, as is usually indicated in general street lighting schedules) has been advanced one hour in each case.

MAY, 1918.

Night of May	All-Night Schedule. Light.	Extinguish.	Moonlight Schedule. Light.	Extinguish.
1.....	**8:25**	5:30	**8:25**	1:45
2.....	**8:25**	5:30	**8:25**	2:25
3.....	**8:25**	5:25	**8:25**	3:00
4.....	**8:25**	5:25	**8:25**	3:35
5.....	**8:30**	5:25	**8:30**	4:05
6.....	**8:30**	5:25	**8:30**	4:35
7.....	**8:30**	5:25	**8:30**	4:55
8.....	**8:30**	5:20	**8:30**	4:50
9.....	**8:30**	5:20	**8:30**	4:50
10.....	**8:35**	5:20	**8:35**	4:50
11.....	**8:35**	5:20	**8:35**	4:50
12.....	**8:35**	5:20	**9:30**	4:50
13.....	**8:35**	5:15	**10:25**	4:45
14.....	**8:35**	5:15	**11:05**	4:45
15.....	**8:40**	5:15	**11:45**	4:45
16.....	**8:40**	5:15	12:15	4:45
17.....	**8:40**	5:15	12:40	4:45
18.....	**8:40**	5:10	1:05	4:40
19.....	**8:40**	5:10	1:30	4:40
20.....	**8:40**	5:10	1:55	4:40
21.....	**8:45**	5:10	2:20	4:40
22.....	**8:45**	5:10	2:50	4:40
23.....	**8:45**	5:10	No light	
24.....	**8:45**	5:05	No light	
25.....	**8:45**	5:05	No light	
26.....	**8:45**	5:05	**8:45**	**10:05**
27.....	**8:50**	5:05	**8:50**	**11:00**
28.....	**8:50**	5:05	**8:50**	**11:45**
29.....	**8:50**	5:05	**8:50**	12:25
30.....	**8:50**	5:05	**8:50**	1:05
31.....	**8:50**	5:05	**8:50**	1:35

Tables for each month of the year, rules for the two schedules given above and for modifications of them, corrections for standard time and latitude, monthly and yearly total hours of burning for the five most common schedules, as well as other information pertinent to the subject, are printed in a booklet obtainable from the ELECTRICAL REVIEW for 25 cents a copy.

Contracting-Construction

Last Two Sections of Part III, Safety Code—Useful Kinks —Contractor Stirs Employes' Loyalty—Among Contractors

PART III OF THE NATIONAL ELECTRICAL SAFETY CODE.

Rules for the Installation and Maintenance of Electrical Utilization Equipment—Sections 38 and 39.

[*The* ELECTRICAL REVIEW *has found that electrical contractors are quite unfamiliar with the National Electrical Safety Code, drafted by the Bureau of Standards, Washington, D. C. This new Code aims to minimize the life hazards connected with the use of electricity. Part III of the Code is of special importance to contractors, who will be called on more and more to make their installation work conform to its requirements. To acquaint them with this portion of the Code, Part III is being reproduced in these columns, Sections 30 to 37 having appeared in the five successive issues from March 16 to April 13. Sections 38 and 39 with discussions appear below. This concludes Part III.*]

SECTION 38.—ELECTRICALLY OPERATED CARS, CRANES AND ELEVATORS.

380. Guarding Live and Moving Parts.

(*a*) All current-carrying parts connected to circuits above 150 volts to ground shall be so isolated or guarded that no person can inadvertently come in contact with them. (See Rule 306 for trolley wires, etc.)

(*b*) *Conductors.*—All conductors over 150 volts to ground in locations accessible to the public shall be run in conduit, armored cable, or molding, the exposed metallic parts of which shall be permanently grounded.

(*c*) *Equipment.*—Guards for the current-carrying parts of unisolated electrical equipment, such as controllers, motors, transformers, automatic cutouts, circuit-breakers, switches and other devices, shall consist of cabinets, casings, or shields of permanently grounded metal or of substantial insulating material.

(*d*) *Arcing or Suddenly Moving Parts.*—All such parts of electrical equipment, including fuses and the handles and arc chutes of circuit-breakers, shall be so isolated or guarded that the liability of persons being struck or burned by sparking, flashing, or movement during operation is reduced as far as practicable.

381. Grounding Non-Current-Carrying Parts.

(*a*) All exposed non-current-carrying metal parts of electrical equipment at over 150 volts to ground shall be permanently grounded. In electric cars all steam or hot-water heating devices accessible to the public shall also be grounded.

The ground connection through well-bonded track rails will be considered satisfactory for equipment on cars and cranes.

(*b*) The metallic parts of portable cranes, derricks, hoists and similar equipment on which wires, cables, chains or other conducting objects are maintained should be provided with an effective protective ground (see Section 9), where operated in the vicinity of supply lines operating at over 150 volts to ground, whether the cranes or similar equipment are themselves electrically operated or not.

382. Control of Energy Supply to Cars and Cranes.

(*a*) Readily accessible means shall be provided whereby all conductors and equipment located in or on cars or cranes can be disconnected entirely from the source of energy at a point as near as possible to the trolley or other current collectors.

(*b*) A circuit-breaker or switch, capable of interrupting the circuit under heavy loads, shall be used unless the current collector can be safely removed, under heavy loads, from the trolley or third rail.

(*c*) Where a car is operated in locations other than private rights-of-way and equipped with both trolley and third-rail current collectors, means shall be provided by which any exposed third-rail collector can be readily disconnected from the trolley circuit when not in use.

383. Control of Movement of Cars, Cranes, and Elevators.

(*a*) Means shall be provided whereby the operator (whether motorman or elevator attendant) can prevent the starting of the equipment by unauthorized persons while he is absent from his post.

Removable reverse levers or controller handles and locked doors to the operator's cab are among the most effective means.

(*b*) The car-control lever of passenger elevators should be located so that the operator can readily face the principal car opening. For cars and traveling cranes the car control should be so located that the operator can readily face the direction of travel.

384. Subway and Car Lighting.

Subways and similar locations used for passenger transportation where artificial illumination is indispensable shall be lighted throughout their entire length by a system independent of the current for electric traction where such is used. It is recommended that passenger cars operated in such locations and lighted normally by the current for electric traction shall be equipped with an auxiliary system of emergency lighting.

SECTION 39.—TELEPHONE AND OTHER SIGNAL APPARATUS ON CIRCUITS EXPOSED BY SUPPLY LINES.

390. Guarding Non-Current-Carrying Parts.

(*a*) Where telephone or other signal apparatus (not included under *b* below) which must be handled by persons is permanently connected (not including portable telephones) to overhead signal circuits exposed by supply lines over 400 volts to ground, provision shall be made by one of the following methods against shock to persons handling apparatus:

(1) The use of suitable protective devices, including fuses and arresters.

(2) The grounding of all exposed non-current-carrying metal parts and the suitable guarding of all ungrounded current-carrying parts. (See Rule 391.)

(3) The arrangement of apparatus in such a way that persons using it will be obliged to stand on a suitably insulated platform, in a suitably insulated booth or on other insulating surfaces. (The above applies only where apparatus is accessible to none but authorized persons.)

(4) The arrangement of apparatus (on signal circuits exposed to supply lines of more than 750 volts to

ground) so as to have no exposed current-carrying parts exceeding 2 square inches in area with which a person is liable to come in contact and the use of suitable protective devices, including fuses and arresters or other means.

(*b*) Such signaling devices as fire and police-alarm boxes and telegraph test boxes, if connected to overhead signal circuits exposed by supply lines over 400 volts to ground, should have the accessible non-current-carrying metal parts permanently grounded wherever the character of service gives valid objection to the use of arresters or transformers on the signal circuit.

Police-alarm boxes, where connected to overhead police-alarm circuits, should usually be protected by arresters operating at 400 volts to ground, placed in the connecting leads outside the box.

Fire-alarm boxes connected to overhead circuits, if not protected by arresters, should be provided with suitable insulating material between the circuit within and the exposed frame and operating hook, this insulation to be capable of withstanding the highest voltage of the supply circuits to which the fire-alarm circuit is exposed up to 7500 volts.

391. Guarding Current-Carrying Parts.

(*a*) Telephone or other signaling devices which are permanently located outdoors or where exposed to corrisive fumes or dampness (such as may occur in subways, cellars, basements, laundries, stables, etc.) shall be so arranged that all ungrounded current-carrying parts are so guarded as to be suitably protected against the prevailing atmospheric conditions.

The inclosing cases of signal apparatus provide suitable guards if substantially built of metal or insulating materials.

(*b*) Receiver cords shall be guarded by shields of permanently grounded metal (such as metal armor) or of non-absorptive insulating material (such as flexible insulating tubing) or shall have suitable insulating coverings for the individual conductors.

(*c*) Where no protective device is installed (permissible only for fire-alarm or similar apparatus or for apparatus not for public use, where the character of service precludes the use of arresters and fuses) the shields of portable cords shall always be of grounded metal or of special insulating material suitable to withstand the voltage of the highest supply circuit to which the signal circuit is exposed up to 7500 volts.

392. Protection Against Induced Voltages.

(*a*) All telephone or other signaling equipment which must be handled by persons and which is connected to a line that parallels a supply circuit in such manner that by reason of exposure to the supply circuit under normal operating conditions more than 150 volts are induced between the terminals of the signaling equipment and ground, shall be protected by one or more of the following means:

(1) All exposed metal parts of the equipment shall be insulated from the circuit, and the circuit shall be protected by arresters having a breakdown potential not exceeding one-half that of the insulation between the above-named non-current-carrying metal parts and the current-carrying parts.

Cords shall have an additional insulating tubing protection.

(2) All exposed non-current-carrying metal parts shall be permanently grounded and all current-carrying metal parts shall either by permanently grounded or adequately shielded. (See Rule 391.)

(3) All equipment shall be so located that persons coming into contact with the equipment shall be obliged to stand either on an insulated platform or in a booth of suitable insulating material.

393. Grounding of Arresters for Signaling Systems.

The ground connections for outside installations of cable protectors employed solely to prevent electrical injury to the cable need not conform with the requirements of this rule. For rules governing the grounding of the metal cases of outdoor apparatus as covered by this section, see Section 9.

(*a*) Arresters shall be permanently and effectively grounded in the following manner:

(1) *Ground Conductor.*—The ground conductor shall preferably be of copper (or other material which will not corrode under the conditions of use) and shall be not less than No. 18 in size and in urban districts or where within buildings shall be covered with a suitable insulation.

If necessary to guard the ground conductor from mechanical injury (on poles or where a ground conductor on the outside of building walls is near a roadway, sidewalk, or pathway, thus necessarily exposing it to tampering by unauthorized persons), it shall be protected for a distance of 8 feet from the ground by a wooden molding or by conduit of non-magnetic material.

(2) *Ground Connection.*—The ground connection shall be made to a cold-water pipe, where available, connected to the street mains and in service. An outlet pipe from a water tank fed by a street main may be used provided such outlet pipe is adequately bonded around the tank to the inlet pipe connected to the street main.

If a cold-water pipe is not available, the ground connection may be made to a gas pipe, provided the ground conductor is attached to the pipe between the meter and the street mains.

If cold-water or gas pipes are not available, the ground connection may be made to an iron rod or pipe driven into permanently damp earth, or to a plate or other body of metal buried in permanently damp earth. (Compare Rule 93.)

Steam or hot-water pipes should not be used for ground connections.

Driven rods or pipes, used as ground connections for protectors, shall not be also used as ground connections for electrical supply circuits or electrical apparatus, and where water or gas pipes are used for a ground connection, attachment to such pipes shall be made at a different point than for attachments to electrical supply circuits or equipment.

(*b*) *Connecting Ground Conductor to Pipes.*—Ground conductors shall be attached to pipes by means of suitable ground clamps; the entire surface of the pipe to be covered by the clamp shall be thoroughly cleaned.

(*c*) *Connecting Ground Conductor to Driven Rod or Pipe.*—The ground conductor shall be so attached to the rod or pipe as to give reliable connection both mechanically and electrically and in such a manner as to prevent corrosion when the joint is buried in the earth.

(*d*) *Connecting Ground Conductor to Buried Electrode.*—Where buried plate or other metal electrode is employed the ground conductor shall be securely fastened to it in such manner as to make a reliable electrical and mechanical contact.

DISCUSSION OF SECTION 38.

380. Guarding Live and Moving Parts.

The number of injuries occurring in electric cars to motormen, conductors and even the public by contact with exposed live parts or ungrounded (and accidentally alive) metal frames is very considerable, probably because the voltages are relatively high, being usually 500 or more to ground, as compared with the common 110 volts to ground of lighting circuits in general use. Many railway companies are adopting very thorough guarding and grounding measures to obviate these hazards. Elevator cages, cables and shop loco-

motives present to a somewhat less degree the same dangers and the efforts to protect them are by no means so uniform or complete. The location of automatic cutouts (circuit-breakers and others) so that flashes will not burn persons is now receiving more attention than formerly.

384. Subway and Car Lighting.

Illumination is one of the best means of preventing panic, while darkness encourages it. The assurance of adequate illumination in emergencies is a first consideration in theater lighting and the same applies to passenger subways. In some cases, storage batteries are carried on cars and are automatically switched on when other sources of energy for lighting fail. In other cases, to obviate the necessity for emergency lights in individual cars, sufficient illumination is provided for the entire subway from two sources, one being automatically switched on when the other fails.

DISCUSSION OF SECTION 39.

390. Grounding Non-Current-Carrying Parts.

(*a*) The number of injuries to persons using telephones, fire-alarm boxes and other devices has been considerable, because of the lack both of effective arresters and of means for preventing a voltage between external metal parts of such devices and the ground or grounded floors on which the persons must stand, or between these external parts and plumbing within reach. The grounding of fire and police-alarm box cases and their accessible metal parts is now almost universally supported, but is still neglected in too many places from a fear that the dielectric between internal current-carrying parts and the case will not withstand the strains from the voltages to which it is subjected by crosses with supply lines. Such a weakness should evidently not be allowed to exist and should never be made a basis for permitting a condition by which high voltage may exist on external metal to which persons have access. Telephones usually should have efficient arrester protection, but with fire-alarm circuits and some other signal circuits the reliability of the circuit necessitates omission of the arresters scattered along the line and not susceptible to immediate attention after operation, and reliance in these cases must be placed wholly on the grounding of exposed metal parts of apparatus accessible to the public.

(*b*) Telegraph instruments expose so little surface to personal contact that the danger of shock is considerably reduced, and it has seemed reasonable to permit use of arresters whose breakdown voltage is somewhat higher than will suitably protect users of telephones, which present much larger metal areas to contact with the hand and face.

391. Guarding Current-Carrying Parts.

Subway types of telephones and other signal apparatus have been developed which provide protection against breakdown of insulation under conditions of dampness prevailing. Since the cases of such equipment will be grounded, where signal circuits are exposed to neighboring high-voltage lines, unless suitable protectors are used, adequate for the insulation, the principal personal hazard will be through cords.

Where protectors are used, a cord having insulation capable of withstanding perhaps double the breakdown voltage of the arrester should usually provide adequate protection in dry places, but in damp places additional protection is needed. Where no protectors are provided, as in some cases at police boxes, train-conductor call boxes, and similar locations, very effective cord protection by insulating tubing or grounded metal tubing is evidently essential.

392. Protection Against Induced Voltages.

The voltage induced between the terminals of signaling apparatus connected to overhead circuits and ground depends on a great many factors, and in general it will be found simpler to measure it than to compute it. This induced voltage can most readily be measured by an electrostatic voltmeter with the signaling circuit in normal operating condition. When an electrostatic voltmeter is not available, the voltage can be estimated from the indications of an electromagnetic voltmeter.

In the case of balanced three-phase circuits, the induced voltage in near-by circuits is predominantly electrostatic for the types of circuit ordinarily used. The voltage limit of 150 volts is about the maximum which would be induced electrostatically by a balanced non-transposed 6600-volt circuit in signaling circuits on the same pole line 6 feet away. It is approximately that which would be induced by a 30,000 to 50,000 volt non-transposed supply circuit in a signaling circuit paralleling it at a distance of 50 feet, unless this circuit were partly shielded by the presence of other wires. In cases in which the signaling circuit does not parallel the supply circuit for the entire distance, the induced voltage is reduced by the effect of those portions of the signaling circuit remote from the supply circuit.

Frequently the transposition of conductors in a metallic return supply circuit will assist materially in preventing induced voltages over 150 to ground on neighboring signal circuits.

393. Grounding of Arresters for Signaling Systems.

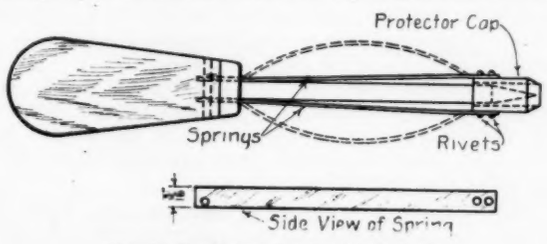
By comparison of these grounding requirements with those of Section 9, it is seen that these are less severe, although generally of the same character. Since these arresters are not called upon to operate frequently, the protection afforded is therefore not so constantly demanded as that of circuit or equipment grounds; and therefore artificial grounds of comparatively high resistance are less likely to dry out so as to still further increase the resistance and reduce the protection afforded.

THE END.

POINT PROTECTOR FOR AWL.

BY A. GEMMELL.

When putting in small wood screws I have been in the habit of using an awl a good deal before starting the screw. A short while ago I jabbed myself quite badly with it, so I devised the scheme that I have drawn out on the sketch herewith and I find it has solved the problem. The dotted lines show how the springs will bend out when the cap is pushed in while



Simple Protector for Point of Awl.

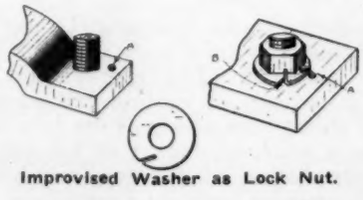
one is making a hole, and when the hole is made the cap will jump back over the point. Note the large hole in the spring is a little to one side, so as to allow the rivet to pass by the shank of the awl in the handle. With this protector an awl can be carried with safety at all times. Use of the awl saves considerable time compared with drilling a hole before driving the screw.

A SIMPLE LOCK NUT.

BY CHARLES H. WILLEY.

We were troubled with the nuts loosening up on some of our machinery, due to vibration, or other reasons, and as no lock nut could be used, and it was not feasible to pin the nuts, we had to use some sort of locking device. Necessity is the mother of invention, for, while experimenting, it brought about the highly successful lock washer shown herewith.

These sketches are quite clear, but it may be well to say that the hole A should be as generous as reason-



Improvised Washer as Lock Nut.

able for receiving the lip. Any ordinary washer can be used. The lip B is cut in with a hack saw before applying the washer. This is turned up as shown, and with a punch or drift, the lip A is impressed into the hole.

CONTRACTOR DEMANDS LOYALTY TO FLAG AND GOVERNMENT.

The Tri-City Electric Company, the well-known contracting firm of Moline, Ill., recently attached the following letter to the pay checks of its employes:

"We are handing to you today with your pay check a thrift stamp and card and it is our earnest wish that this will induce you to fill the card and as many more as you can. It is not given to you as a present, nor has it anything to do with wages, but it is to persuade you that in investing your money in this way you are helping your government win the war. This company has done and intends to do all it can to help. We have helped sell bonds and stamps, have bought bonds, have contributed to the Red Cross, Y. M. C. A., Knights of Columbus and War Chest funds and belong to the National Security League and have done investigating in regard to money slackers employed by others. We do not wish to have any reflections cast upon this company by employing anyone who is not loyal to this government and flag and who will not invest some part of his savings to help the cause we are fighting for. Any seditious or disloyal word uttered by any employe will result in immediate discharge."

AMONG THE CONTRACTORS.

The Hoobler Electric Company of Streator, Ill., recently did the wiring for light and power in Sherman School building in that city, the job amounting to $1500. Included in this was the installation of a motor for the ventilating system.

The Auburn Electric Company, Omaha, Nebr., is wiring a large mill building for the Miller Cereal Mills Company of Omaha. Motors aggregating 260 horsepower and 200 lighting outlets are being installed. All the wiring is in conduit. The contract price is about $3000.

The Electric Shop, 1403 Washington avenue, Racine, Wis., is wiring the Franksville Bank building, the Jones stores and flats and the Lawton store and flats, the last two being in Racine. Fixtures are also being furnished and installed in the stores and apartments named.

Miller-Santee Company, Rockford, Ill., has completed the wiring of the Central Union Telephone Company's remodeled building, whereby its service capacity was more than doubled. Other work in progress consists in wiring the Forest City Bakery Company's concrete building and installing motors to operate the bakery machinery.

Jere Woodring & Company, of Hazleton, Pa., have been awarded a contract to install electrical equipment in the Sandy Run colliery of M. S. Kemmerer & Company. The management of the latter company is arranging to have the entire colliery operated by electricity in the near future.

The Hughett Electric Company, La Salle, Ill., has had a good run of contract work, of which the following may be mentioned: The Oglesby State Bank, consisting of installation of lighting fixtures and a conduit job of wiring; the wiring of the four floors of L. V. Orsinger's wholesale bakery in La Salle, and the complete installation of fixtures, switchboards and motors. The motors represent a capacity of 150 horsepower. The contract amounted to about $4000. The Hughett Company also wired the E. G. Newman flats in La Salle and installed lighting fixtures therein, the contract amounting to $550. The wiring of the Thompson flats and putting in fixtures is in progress.

The Berger Electric Company, Joliet, Ill., recently completed the wiring and fixture installations in the new Boston Store, the entire piece of work having amounted to about $8000. This company will soon have completed wiring and indirect light installations in the service building and office of Standard Oil Company, Joliet, which ran up to $2600. The rewiring of the Will County Court House, at Joliet, is also included among its contracts, amounting to $4500.

The N. Sausen Electric Shop, Peru, Ill., lately did the necessary wiring at the Illinois Zinc Company's coal mine, to provide for charging batteries by which its coal haulage cars are operated. The coal cars referred to are used on the several mine levels for hauling coal to the vertical shaft through which it is hoisted. Another contract being put through by the Sausen firm is on the up-to-date farm of William Neurenther, near Peru. This consists of wiring and motor installations for grain elvators, pumps, and domestic appliances, making a thoroughly electrified farm.

W. L. Fowler, Cedar Rapids, Iowa, has in progress the installation of conduits and wiring in the new Y. M. C. A. building in that city, and the installation of motors for ventilating fans. The building is of reinforced concrete, and the conduits are set in the slab construction. His contract amounts to $4500. He has about completed the wiring of the eight-story Higley office building, in which Reflectolyte fixtures are being put in. A motor-generator set is being installed for converting alternating to direct current for the elevators. This job amounts to $15,000. Another piece of work in hand is wiring and piping for the signal system of the central fire station, Cedar Rapids. This work amounts to $1500.

A. H. Cox & Company, 307 First avenue South, Seattle, Wash., have in the past 60 days wired and installed electrical equipment on six cranes for the Queen City Machine Works, which have the rather novel feature of a closed-circuit automatic switch attachment and other features which are said to make them the first of their kind. The design for these cranes was gotten out by Manager Edwards of the Queen City Machine Works. A. H. Cox & Company have also just completed installation of the electrical equipment on a ten-ton marine elevator at the Oregon-Washington dock, same to be operated by a variable-speed, 25-horsepower Allis-Chalmers motor. This is the second elevator of this kind to be installed on this dock.

The Milwaukee office of Henry Newgard & Company, Chicago, has recently completed two important contracting jobs. One of these was for the Paramount Knitting Company, at Waupun, Wis., where 150 horsepower in motors and 280 lighting outlets were installed; there was also included a switchboard, four 10-circuit Newgard cabinets and panels, 235 Ivanhoe-Regent steel reflectors, besides numerous drop cords and the complete rehabilitation of all the wiring in the company's old plant. One of the Milwaukee, Wis., contracts covered the electrical installation in the Monarch Manufacturing Company's plant, and included 683 outlets for lighting, 302 sewing-machine outlets and adjustable fixtures, 675 drop cords with Ivanhoe-Regent steel reflectors, eight 300-watt Brascolite fixtures type A-C., two 600-ampere Allen-Bradley remote-control switches, 46 cutting-machine outlets, trolleys and cords. Joseph W. Pfeifer, Milwaukee manager for the Newgard company, was the engineer for Monarch Manufacturing Company.

BOOK REVIEWS

"Powdered Coal as a Fuel." By C. F. Herington. New York: D. Van Nostrand Company. Cloth, 211 pages (6 by 9 inches), 84 illustrations. Supplied by Electrical Review Publishing Company, Inc., for $3.00.

This book, as its name implies it should, embraces the use of pulverized or powdered coal as fuel. The book is divided into ten chapters, followed by a very complete and highly commendable bibliography and index. Chapter I covers the general operation of a pulverizing plant, making comparisons of cost with gas and oil as fuel. Chapter II discusses the suitability of various coals, tells of experiments and the influence of ash. Chapter III covers the processes through which the coal must pass before fit for application to the furnace chamber, namely, crushing, drying, pulverizing and air separation. The next chapter, Chapter IV, takes up the matter of feeding the coal to the furnace and there burning it, a subject embracing furnace shape and design, forms of burners and methods of pneumatic distribution. These four chapters might be said to comprise the first section of the book, namely, the preparation and combustion of coal in pulverized form.

What might be considered as the second section of the book covers the application of pulverized coal to various purposes. Chapter V takes up the application of powdered coal to the cement industry, Chapter VI to reverberatory furnaces, and Chapter VII in metallurgical furnaces. Chapter VIII deals with coal under boilers in general and discusses in particular the already fairly well known installations of the General Electric Company at Schenectady, the Missouri, Kansas & Texas Railroad installation at Parsons, and that of the American Locomotive Company, also at Schenectady. The descriptions of these plants are, however, rather general, the test data already published not having been drawn upon to as large an extent as might have been wished for the sake of those not in close touch with the progress already made in applying powdered coal to steam-making boilers. Chapter IX discusses the use of powdered coal under locomotive boilers, an important application and one of special interest at this time when some railroads are already being forced to abandon oil fuel because of expiring fuel contracts and with existing conditions created by the coal situation, the zoning system of coal distribution now being formulated and the need for obtaining maximum efficiency and performance from existing locomotives.

The book covers the subject of powdered coal in a way that should enable any one so desiring to obtain a good idea of what has been accomplished and the difficulties that have had to be overcome in placing the combustion of pulverized fuel where it stands today. It is a little unfortunate that more test and cost data are not included in the book, although this is not really so very important since accessible elsewhere. The inclusion of a bibliography is a welcome and valuable feature of the book. At the present time when the fuel situation is less acute only because warmer weather has come; when coal prices, also oil, are so high; when low-grade fuels near at hand are being used in preference to better grades of coal that must be rail borne for longer distances and when serious attention is being turned to the lignites and other forms of fuel not long since thought of as hardly worth while considering, pulverized coal deserves serious consideration as a means of economy and conservation. For those trying to find relief from existing conditions by the adoption of powdered coal, "Powdered Coal as a Fuel" should be found as useful as it is interesting, for it gives an understanding of the status of powdered coal at the present time and the difficulties that have been encountered.

I. L. KENTISH-RANKIN.

"Electrical Measurements." By Frank A. Laws. New York: McGraw-Hill Book Company, Inc. Cloth, 719 pages (5½ by 8 inches), 442 illustrations. Supplied by the Electrical Review Publishing Company, Inc., for $5.00.

This is the third volume of Electrical Engineering series of textbooks prepared under the supervision of a committee of prominent engineers and teachers of electrical engineering.

The book is one of the most complete treatises on fundamental electrical measurements in the English language. Dynamo laboratory tests are not included. "The choice of material and the method of treatment have been determined by the author's experience in directing for many years the work of the laboratory for technical electrical measurements at the Massachusetts Institute of Technology, and the book is intended as a text for the guidance of students working in such a laboratory as well as a general reference book on the subject."

The characteristics of the book show the handiwork of a master in electrical measurements. The descriptions are clear and sufficient theory is given to enable the student to conduct the measurements intelligently. A selected list of references follows each chapter. This is a very useful feature for in many instances it is impossible to give detailed explanation and recourse must be had to original papers.

In the discussion of the Wheatstone bridge the author points out that this apparatus was really invented by S. Hunter Christie of the Royal Military Academy at Woolwich, some ten years before its use by Wheatstone. This will undoubtedly be news to most readers of the book. There are other cases on record in which credit is wrongly attributed. On page 73 the author shows the absolute electrodynamometer of the Bureau of Standards. The writer recalls many experiences, some pleasant and others not so pleasant, in connection with the making of that piece of apparatus. The cylinder is of plaster of paris and not marble, as the reader might infer in reading the text. Experiments showed that marble was magnetic to such a degree as to make its use uncertain. The marble-like appearance of the cylinder is due to paraffin in which the cylinder was soaked. Memories of experiences are responsible for this digression.

All of the arrangement and treatment in the book is of such a degree of excellence it is difficult to single out special features for comment. Some of the instruments described, such as the tangent and Thomson galvanometers, have mainly a historical interest, nevertheless for reference they are properly included. The chapter on the Determination of Wave Form is a most excellent and comprehensive treatment of the subject.

In commenting on the first two volumes of this series the writer stated that they set a high mark in electrical engineering texts. Professor Laws has produced a text which still keeps the excellence of the series at the same level, if not higher. To those in search of a practical text on electrical measurements the reviewer would say, seek no further.

C. M. JANSKY.

New Appliances

Polarized Plug—Two Types of Lightning Arresters—Picture Machine—Coal Conveyor—Warming Pad—Fixture

NEW HEAVY-DUTY POLARIZED ATTACHMENT PLUGS.

Harvey Hubbell, Inc., Bridgeport, Conn., is placing on the market a new heavy-duty polarized attachment plug, known as No. 5598. This plug was designed to be used interchangeably with the Hubbell line of heavy-duty polarized wall and flush receptacles. It is rated at 660 watts, 250 volts. The base is constructed of porcelain and the cap is brass-covered for protection against breakage.

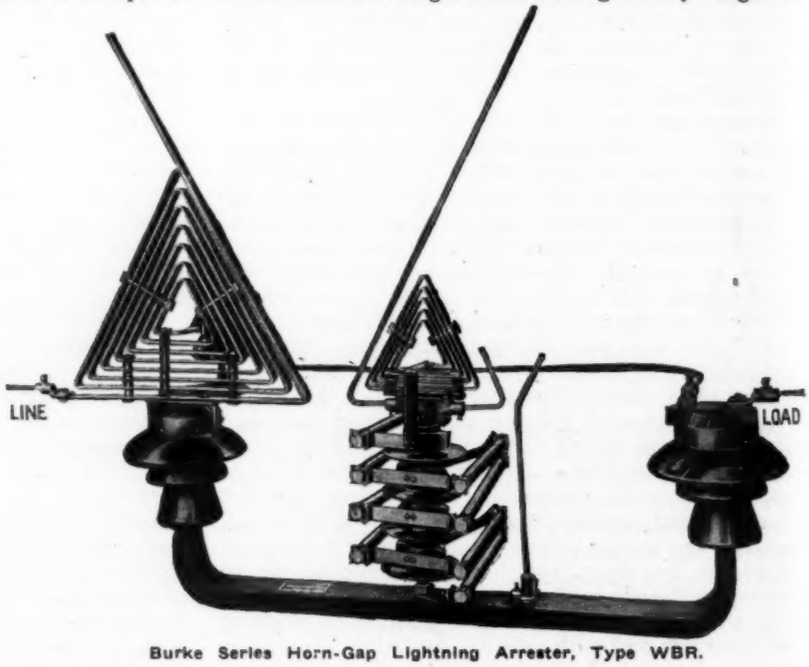
The knife-blade contacts are of sturdy construction, with blades at right angles to each other to effect polarization, making the plug desirable for use in connection with instruments, or in fact any apparatus where absolute polarization is required.

New Hubbell Attachment Plug.

NEW BURKE SERIES HORN-GAP LIGHTNING ARRESTER.

Outdoor switching stations and substations have greatly increased both in number and capacity in the last few years. It is not extraordinary to find such substations with capacities of 100,000 kilovolt-amperes or over and arranged for voltages up to 130,000. When the capacity of the substation and of the system with which it is connected is greatly increased, it is obvious that the carrying capacity and ruggedness of the equipment used must also be increased. These increasing capacities therefore call for outdoor substation equipment of different characteristics than those of the equipment heretofore found adequate.

In the line of horn-gap lightning arresters this need has been recognized by the Railway & Industrial Engineering Company, Pittsburgh, Pa., which has brought out a type of Burke series horn-gap lightning arrester of greatly increased capacity. In general design it resembles the Burke arrester of this type formerly built, but has a series resistance in the ground path of different characteristics. This resistance is made of what is known as Koppat, as formerly, but has an increase of capacity of about 300 per cent. The arrangement of this resistance is much sturdier than for the smaller capacities, so that the new arrester is able to relieve excess voltages and discharge heavy surges repeatedly without deterioration. This series resistance is shunted by a short auxiliary horn-gap that is connected directly to ground; it can be seen to the right in the accompanying illustration. In case of a heavy discharge to ground, the arc jumps across this auxiliary gap, but is almost instantly broken, thus inserting the resistance in the path to ground in series with the power arc to limit it while it is being broken on the main horn-gap.



Burke Series Horn-Gap Lightning Arrester, Type WBR.

These Burke arresters are made in two types. Each includes the well-known Burke triangular reactance or choke coil on the line side of the main horn-gap, and the Koppat resistance between the other side of the main horn and ground, and the small auxiliary gap in shunt with this resistance. What is known as the type WB has a plain horn above the ground resistance, whereas the type WBR shown herewith has this horn include a triangular coil connected in series between the horn proper and the ground resistance. This coil aids

in limiting the rush of power to ground and relieves the resistance of the heavy strains by smoothing out the surge before it reaches the resistance. This makes this type of arrester especially suitable for use on very large systems of heavy capacity where surges of great capacity are experienced or where serious lightning disturbances occur frequently. This reactance does not affect the sensitiveness of the arrester, but helps to make it still more rugged.

A COMPRESSION-CHAMBER ARRESTER FOR 10,000 AND 13,200-VOLT CIRCUITS.

To protect pole transformers, on 10,000 and 13,200-volt distributing lines, the General Electric Company, Schenectady, N. Y., has developed a unique form of compression-chamber, multigap lightning arrester in which is embodied the shunt resistance principle. This is shown in Fig. 1.

In the usual form of multigap shunt-resistance arrester, the resistances shunt the gaps. In this form, the gaps shunt the resistances. The gaps are mounted on and insulated from the resistance rods. The arrangement of the gaps and resistances is shown in Fig. 2.

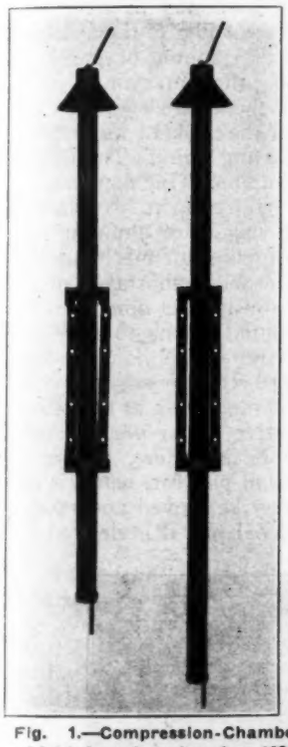


Fig. 1.—Compression-Chamber Lightning Arrester for 6600, 11,000 and 13,200-Volt Service.

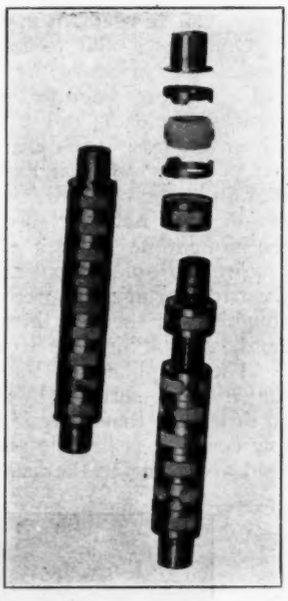


Fig. 2.—Shunted Resistance Units Used With Compression-Chamber Arrester.

Sensitiveness to lightning disturbances is obtained by this combination of gaps and resistance rods used as shunts, all mounted in a porcelain tube.

By reason of this combination of gaps and resistances the arrester will discharge at low rises in potential, is sensitive to lightning over a wide range of frequency, and following the lightning discharge, quickly cuts off the generator current and prevents "grounds" or "shorts."

A number of paths for the lightning discharge through the arrester are offered by the four units of shunting resistance used. As the resistance rod in contact with the series gap is grounded through the other resistances, the initial discharge is made easy because the ground potential is brought up to the bottom of the series gaps. The path which the discharge takes after passing through the series gaps depends on the frequency and quantity. Very high frequency will discharge straight across all the gaps. Discharges of lower frequency will take place through one of the shunt paths.

The generator current which follows the lightning discharge will shunt to the resistance rods. This limits it to an amount that can be extinguished readily by the gaps.

The arrester affords complete protection and is light, efficient, compact and proof against fire and weather.

A NEW PARLOR MOVING-PICTURE MACHINE.

A new type of moving-picture machine for commercial, educational and home use has been brought out by the Pathescope Company of America, New York, N. Y. This machine is the latest model of this company's well-known line of Pathescopes and is known as the New Premier Pathescope. Its special features are drive by a motor that can be used on both direct and alternating currents, high illumination, and a feed mechanism that gives practically perfect results.

Motor drive was used on the older types of Pathescopes, but it was necessary to have separate motors for the different kinds of current, and this naturally limited the use of the motor-driven machines. The New Premier Pathescope is, however, driven by a Westinghouse "Sew-Motor," which operates at practically the same speed with either kind of current. Hence this machine can be used wherever there is electric light.

The illumination is provided by a 14-volt, 2-ampere, argon-filled, high-efficiency lamp, that is sufficiently brilliant for throws as long as 100 feet, and for pictures up to 12 feet wide. The 110-volt current received from the lighting circuit is reduced to low voltage for the use of the lamp by means of a rheostat; this rheostat is adjustable so that the degree of illumination can be varied to suit conditions.

The film-moving mechanism is of the intermittent type and is of novel design. The manufacturers claim that the New Premier Pathescope projects an absolutely flickerless picture.

This machine is absolutely safe to use, since it can take only slow-burning films, the standard celluloid film being unusable in it. Many hundreds of these special films have already been made up by the Pathescope Company; special subjects can be made up as desired and standard films can be copied on to the special stock.

The weight of the machine is 23 pounds and it is arranged for packing in a carrying case similar to a small suit case.

GODFREY COAL CONVEYOR.

The Government's appeal for coal users to lay in their supplies of coal now and during the summer months instead of waiting until the fall and winter comes, when the railroads are overloaded with shipping grain or coal as the case may be, the experience of the past winter, the high costs are all combining to make the matter of coal storage of live interest and vital concern. The sum total is that coal storage piles

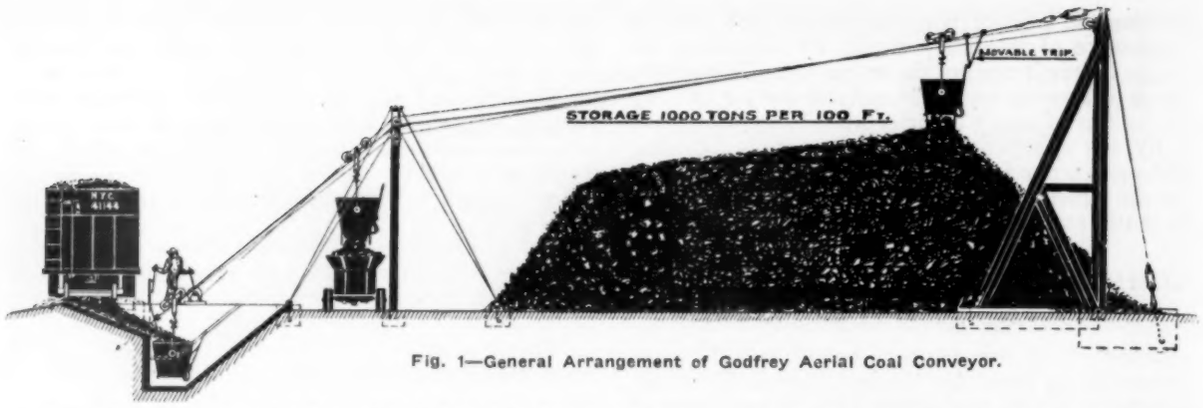


Fig. 1—General Arrangement of Godfrey Aerial Coal Conveyor.

are becoming commoner sights with industrial plants and coal dealers, as well as with the railroads and central stations.

One of the largest items in coal delivery costs today is that of handling, because human labor comes into play so often and so inefficiently. In the smaller power houses, where the expensive cranes and derricks are not feasible, the cost of labor has constituted the chief cost of handling coal, except where topographic conditions permitted the coal cars to be run direct to the bunkers. But even this does not permit of cheap storage of large quantities of coal against emergencies.

The Godfrey coal conveyor has been developed to eliminate the human element wherever possible, modernize coal unloading and storage and at once lower coal handling and delivery costs and lessen the cost of storing coal.

The general layout of the Godfrey coal conveyor is shown in Fig. 1. The method comprises a coal pit adjacent to the railroad track, an aerial transporting cableway, supporting structures and conveying buckets. A bucket is used of 1-ton capacity, which is dropped into a pit at the side of the railroad track and filled from a chute which receives the coal from the hopper bottom of the coal car. The bucket is hauled up an incline track, being supplied with trunnion rollers at each side which operate upon the track, and is lowered upon the top of the pile or bin. A trigger releases the bottom of the bucket and the weight of the coal causes the bucket to empty, when the spring bottom immediately closes and is ready for another load. In order to get the bucket back to the starting point, a double drum arrangement and a double pulley on the carrier are used.

The length of the aerial cableway may be varied, of course, to local conditions, and may be made as long and as short as desirable, according to the amount of coal it is desired to store. A motor or gasoline engine can be used for operating the conveyor.

One man is able to control the entire operation of the unloader or conveyor, lower the buckets, raise them and bring them back to the starting point. The buckets are self-closing and self-dumping. One man standing in one position is able to handle up to 50 tons of coal per hour, whether loading wagons or dumping the coal on to the coal pile. This method of mechanically moving coal not only solves the labor shortage but at the same time reduces enormously the time usually required to unload coal cars, thus helping to alleviate the car shortage. Moreover, the coal is handled less roughly and there is thus less breakage and the coal can be sold at higher prices and more of it at the price.

The simplicity of the Godfrey conveyor is such that it may be erected by any one anywhere. There is so little to it that there is little to pay for, hence is of low cost. It is flexible and may be moved and modified according to the size of coal pile it is desired to

Fig. 2—Self-Dumping Bucket on Steel-Track Conveyor.

Fig. 3—Bucket Depositing Coal Without Degradation.

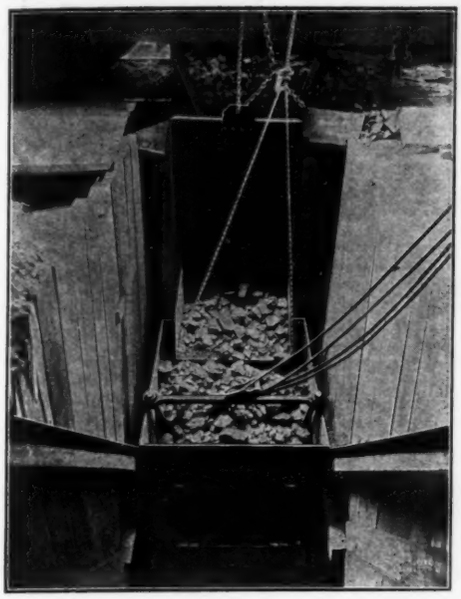


Fig. 4—Grab Bucket on Aerial Conveyor Coming From Coal Pit With Its Load.

use now or next year. In place of aerial transmission, using steel conductors, as shown, a steel track on the ground may be employed where desired.

The Godfrey coal conveyor is not intended to replace the steam shovels and derricks and bridge type unloaders where thousands of tons of coal are handled daily. But it may be used where otherwise coal could not be stored because of high labor charges. For the coal dealer, the smaller plants burning a few hundred of tons of coal a day and the many other instances where several hundred tons of coal have to be handled daily, efficiently and with a minimum expenditure of time and effort, and with the least breakage and damage to the coal, for these purposes the Godfrey coal conveyor has been especially designed. It is manufactured by John F. Godfrey, Elkhart, Ind.

INEXPENSIVE WARMING PAD.

In order to fill the demand for an electric warming pad at a less price than its standard 12 by 15-inch pad, the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has placed upon the market one of these pads whose dimensions are 9 by 12 inches and which retails for $4.50. This pad is equipped with 15 feet of cord, with attachment plug. No switch is provided, the current being turned on and off at the lamp socket, or by separating the attachment plug. To prevent overheating, two thermostats are inclosed in the pad. These are connected in series and should the temperature rise to a point near the maximum safe value, one or the other will open the circuit. Upon a fall in temperature, the thermostat will reclose the circuit, thus maintaining the heat uniform.

This pad, which is inclosed in a fawn-colored felt cover, is very soft and pliable, thus allowing it to conform easily to any part of the body. Its marked superiority to the old-fashioned hot water bottle is well known, some of the advantages being its instant availability, its continued heat at uniform temperature, the absence of any danger of overheating or scalding the patient, or of wetting its surroundings, and the low cost of operation.

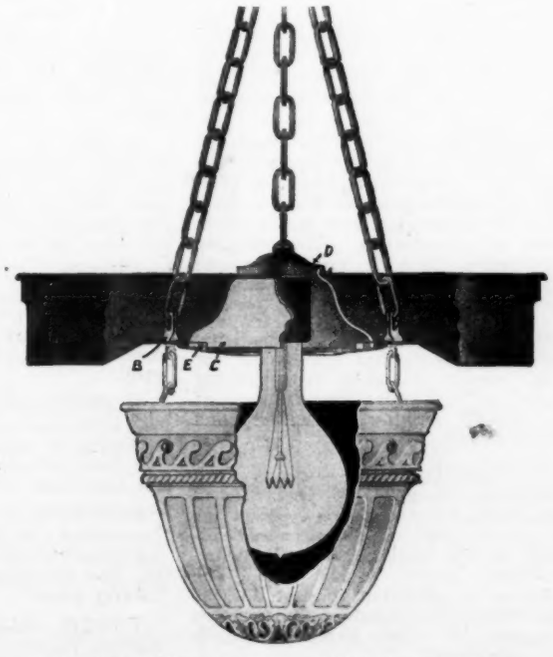
This pad is manufactured in one style only—for a voltage range of 95 to 125, with a consumption of 48 watts at 110 volts.

THE CEILING-BRIGHT REFLECTOLYTE.

Of the types of semi-indirect lighting fixtures that have made possible the use of an approximation of indirect lighting in rooms not especially adapted thereto, because of relatively dark ceilings or other conditions, the Reflectolyte fixtures made by The Reflectolyte Company, 914 Pine Street, St. Louis, Mo., have been conspicuous. These fixtures have included a heavily enameled steel reflector of special shape above the lamp to serve as a miniature ceiling, and an ornamental white-glass bowl below and around the body of the lamp to serve for diffusing the lamp's direct rays. In the Reflectolyte Junior fixtures the reflector is of white opal glass.

In a recently modified form of Reflectolyte, a partial section of which is shown herewith, provision is made for allowing a certain percentage of the light to pass through a central opening in the reflector so as to illuminate the ceiling to a moderate degree and thus make a more cheerful effect than where practically all the light is kept below the horizontal plane. The opening in the reflector is covered by a bell-shaped diffusing glass *C*, which serves to spread the light that passes through it over the ceiling. It in turn is covered by a perforated metal cap *D* that serves for ventilation and with the part *C* helps to exclude dust and dirt from the lamp and lower bowl. The glass part *C* is secured to the reflector by three small clips *E*. The reflector can be quickly detached from the supporting chains by means of patented connecting links *B* so as to facilitate cleaning.

This form of fixture is known as the Ceiling-Bright Reflectolyte, and is made in quite a variety of models, both plain and ornamental. Since only a small part of the light is allowed to pass to the ceiling, the efficiency of the fixture is not greatly affected; for that matter, the light that does reach the ceiling is usefully employed in brightening it and a considerable part is again diffused throughout the room.



Partial Section of Ceiling-Bright Reflectolyte.

Current News

Weekly Record of Construction Activities—Conventions

EASTERN STATES.

CLAREMONT, N. H.—Claremont Power Company is rushing to completion the construction of its substation, and it is expected that operations will be inaugurated at an early date.

GOFFSTOWN, N. H.—Manchester Traction, Light & Power Company has recently awarded a contract for the construction of its proposed power house and dam in the Greggs Falls district of Goffstown. French & Hubbard, 88 Pearl street, Boston, Mass., are engineers.

RUTLAND, VT.—Hortonia Power Company is having plans prepared for the construction of a one-story power house, about 25x90 feet in size, at Middlebury. Grover & Connor, Rutland, are engineers.

BOSTON, MASS.—The United States Government, Navy Department, has had plans prepared for the construction of a power plant at the local navy yards. The structure is estimated to cost $35,000. C. W. Parks is chief of the Bureau of Yards & Docks.

CAMBRIDGE, Mass.—Cambridge Electric Light Company, 46 Blackstone street, has filed plans for the construction of a one-story addition to its boiler plant, about 45x65 feet in size. Contract for the structure, which is estimated to cost $20,000, has been awarded to the John F. Griffin Company, 17 Milk street, Boston.

NORWICH, CONN.—Eastern Connecticut Power Company has had plans prepared for the construction of a one-story power station in the Thamesville District of Norwich. The Harry M. Hope Engineering Company, 185 Devonshire street, Boston, Mass., is engineer.

BINGHAMTON, N. Y.—Binghamton Light, Heat & Power Company has secured a contract from McGill & Hulford for supplying power for the operation of its new machine shop now in course of construction. The company will require about 40 horsepower, and it is expected that operations will be inaugurated in the plant about June 1.

BUFFALO, N. Y.—International Railway Company has announced that it will remove its offices from Ellicott Square to the entire upper floors of the Littell building, Franklin and Huron streets.

CORTLAND, N. Y.——New York Telephone Company, 15 Dey street, New York, has awarded a contract for the construction of the proposed addition to its local telephone building, two-story, about 20x130 feet. The structure is estimated to cost $25,000. The Pulford & Dempsey Construction Company, 157 Flack street, Elmira, is the contractor.

CORTLAND, N. Y. — Southwick Electric Company has filed notice with the Public Service Commission of a change in its corporate name to the Moss Electric Company.

GLENS FALLS, N. Y.—Adirondack Power Company is considering plans for the construction of a power house near Utica. The structure is estimated to cost $100,000.

NEW YORK, N. Y.—A. L. Shemel & Company, 60 East One Hundred and Sixteenth street, manufacturers of electrical supplies, have filed notice with the Public Service Commission of an increase in their capital from $30,000 to $75,000 to provide for expansion.

PORTCHESTER, N. Y.—Liberty Electric Corporation has awarded a contract for the construction of a one-story addition, about 60x100 feet in size at its plant, to cost about $8000. George Mertz & Sons, East Portchester, are the contractors.

SCHENECTADY, N. Y.—General Electric Company has awarded a contract to The Austin Company, Euclid avenue, Cleveland, Ohio, for the construction of a 300-foot extension to its works.

YONKERS, N. Y.—National Sugar Refining Company, foot of Main street, has awarded a contract for the construction of its proposed addition to the boiler plant, of brick and concrete, about 85x95 feet. Estimated cost of the structure is $40,000. Lynch & Larkin, 127 Downing street, Yonkers, are the contractors.

CAPE MAY, N. J.—Vulcan Heat, Light & Power Company has been ordered by the Board of Public Utility Commissioners to continue service to customers connected with its distribution system, and to improve its equipment.

DOVER, N. J.—New Jersey Power & Light Company has contracted with the Rockaway McKinnon Axe Company for supplying additional power to the plant of the company in the amount of about 35 horsepower.

JERSEY CITY, N. J.—Chidester Supplies Company has filed authorization papers to operate at 234 First street for the manufacture of electric novelties. H. Schinkel heads the company.

MORRISTOWN, N. J.—The Board of Education is considering the installation of new motor equipment in the local schools for the operation of the ventilating systems.

NEWARK, N. J.—Weston Electrical Instrument Company, 4 Weston avenue, manufacturer of scientific instruments, etc., has subscribed $30,000 to the Third Liberty Loan.

PERTH AMBOY, N. J.—Public Service Electric Company has recently completed the installation of new equipment at its local power plant, including a 10,000-kilowatt turbogenerator, an exhaust steam condenser, having a cooling surface of 16,500 square feet, and auxiliary apparatus.

PERTH AMBOY, N. J. — Thomas Underground Cable Works, 26 Washington street, have subscribed $75,000 to the Third Liberty Loan.

WEST ORANGE, N. J.—Thomas A. Edison, Inc., Lakeside avenue, has awarded a contract for the construction of foundations and superstructure for its proposed one-story reinforced concrete power house, about 100x100 feet. The Underpinning & Foundation Company, 290 Broadway, is the contractor.

JERSEY CITY, N. J.—General Storage Battery & Repair Company is making extensive improvements and additions to its plant to provide for increased capacity. Fred Hoefeld is general manager.

WEEHAWKEN, N. J.—Weehawken Tungsten Lamp Company, 550 Gregory avenue, is considering plans for the immediate reconstruction of its two-story brick and iron lamp manufacturisg plant recently destroyed by fire with a loss estimated at $25,000.

BRISTOL, PA.—The town council is making improvements at the Pumping station, including the changing of its motive power from steam to electricity.

GREENVILLE, PA.—Mercer County Light, Heat & Power Company has filed notice with the Public Service Commission of the issuance of bonds for $100,000, to provide for extensions, improvements, etc.

MAUCH CHUNK, PA.—The town council is considering plans for improvements in its electric street lighting system.

NEW CASTLE, PA.—Grasselli Powder Company, Cleveland, O., has recently awarded a contract for the construction of a large local power plant in connection with the erection of the eight one-story manufacturing buildings estimated to cost in the neighborhood of $1,000,000.

PHILADELPHIA, PA.—Bell Telephone Company is having plans prepared for the construction of an addition and alterations and improvements in its telephone building at Germantown. John T. Windrim, Commonwealth building, is architect.

PHILADELPHIA, PA.—James F. Buchanan Company, 1719 Chestnut street, has been awarded a contract for the electrical work in connection with the construction of the school building at Fifty-seventh and Haverford avenues being erected at a cost of $113,000. The contract price is $4,988.

PHILADELPHIA, PA.—The George W. Smith Company, Forty-ninth and Botanic avenues, has awarded a contract for the construction of a two-

story brick addition to its boiler plant, about 50x85 feet in size, to cost $35,000. John N. Gill & Company, Otis building, Philadelphia, are the contractors.

PHILADELPHIA, PA. — Germantown Steam Company has had plans prepared for the construction of an addition to its plant at Pelham Road and Hortter street. The company is also planning for improvements and alterations in the existing structure.

PHILADELPHIA, PA.—Louis Walther Manufacturing Company, Torresdale avenue and N street, has awarded a contract for the construction of an addition to its boiler plant. The work, in connection with other improvements, is estimated to cost $21,000. George H. Thirsk, 1919 West Berks street, Philadelphia, is the contractor.

READING, PA.—Metropolitan Edison Company is making rapid progress in the construction of an extension to its transmission system to the mine of the E. & G. Brooke Iron Company, Birdsboro, a distance of about six miles. The Brooke company has commenced the installation of machinery at the mine, and the company will require about 500 horsepower.

PITTSBURGH, PA.—Westinghouse Electric & Manufacturing Company is making rapid progress in the construction of a one-story addition, about 100 x150 feet in size, to its plant at Shadyside Station, at a cost of about $50,000. Bernard H. Prack, Keystone building, is architect and engineer.

WILLIAMSPORT, PA.—Lycoming-Edison Company will expend approximately $75,000 for the erection of an addition to its power plant. The new building will be 25x114 feet in size and three stories high. A new and larger switchboard will be installed together with other equipment.

WASHINGTON, D. C.—Chesapeake & Potomac Telephone Company, Thirteenth and G streets, N. W., has awarded a contract to Andrew Murray, 729 Twelfth street, N. W., for alterations and improvements in its exchange plant at 1420 Columbia Road, and improvements in its plant at 629 B street, N. E., to cost $60,000 and $15,000, respectively.

WASHINGTON, D. C.—The United States Government, Navy Department, has taken bids for the construction of its proposed substation "B" and frequency changer house at the local navy yard. The Dawson Construction Company, Pittsburgh, Pa., submitted the low bid at $51,170.

WASHINGTON, D. C.—The United States Government has awarded a contract to the Turner Construction Company, 244 Madison avenue, New York, for the installation of the proposed distributing system and construction of power plant at G and Twenty-fifth streets. The estimated cost of the entire work is $550,000.

FINCASTLE, VA.—Roanoke & Botetourt Telephone Company, which recently increased its capital from $10,000 to $15,000, is considering plans for extensions and improvements in its plant.

WILLIAMSBURG, VA.—Williamsburg Power Company has filed notice with the Public Service Commission of an increase in its capital from $25,000 to $150,000, to provide for extensions, improvements, etc.

DATES AHEAD.

Pacific Coast Section of National Electric Light Association and California Association Electrical Contractors and Dealers. Joint convention, May 9, 10 and 11, Del Monte, Cal.

National Fire Protection Association. Annual meeting, Chicago, Ill., May 7-9. Secretary, Franklin H. Wentworth, 87 Milk street, Boston, Mass.

National Electrical Supply Jobbers' Association. Annual meeting, May 6, 7 and 8, Del Monte, Cal.

American Association of Engineers. Annual meeting, May 14, 1918. Secretary-Treasurer, A. H. Krom, 29 South La Salle street, Chicago.

Arkansas Association of Public Utility Operators. Annual convention, Arlington Hotel, Hot Springs, Ark., May 21-22-23. Secretary-Treasurer, R. B. Fowles, Pine Bluff, Ark.

Electrical Supply Jobbers' Association. Annual meeting, Homestead Hotel, Hot Springs, Va., May 21-22-23. Secretary, Franklin Overbaugh, 411 South Clinton street, Chicago.

Electrical Contractors Association of Georgia. Annual meeting, Tybee Island, Ga., June, 1918. Secretary, Dan Carey, 614 Chamber of Commerce building, Atlanta, Ga.

American Society of Mechanical Engineers. Spring meeting, Worcester, Mass., June 4-7. Secretary, Calvin W. Rice, 29 West 39th street, New York City.

National Electric Light Association. Annual meeting, Hotel Traymore, Atlantic City, N. J., June 13 and 14. Secretary, T. C. Martin, 33 W. 39th street, New York City.

Texas State Association of Electrical Contractors. Annual meeting, Galveston, Tex., June 15, 1918. Secretary, H. S. Ashley, Fort Worth, Tex.

Southeastern Section, National Electric Light Association. Annual meeting, June 19-20, 1918. Atlanta, Ga. Secretary-Treasurer, T. W. Peters, Columbus, Ga.

American Institute of Chemical Engineers. Summer meeting, Berlin, N. H., June 19-22. Headquarters, Mt. Madison House, Gorham, N. H. Secretary, John C. Olsen, Brooklyn, N. Y.

American Institute of Electrical Engineers. Annual meeting, Atlantic City, N. J., June 26-28. Secretary, F. L. Hutchinson, 33 West 39th street, New York City.

Northwest Electric Light and Power Association; affiliated with N. E. L. A. Annual meeting, September 11, 1918. Secretary, George L. Myers, Pacific Power & Light Company, Portland, Ore.

CHARLOTTE, N. C.—Southern Public Utilities Company will purchase additional machinery. Address general manager.

FOREST CITY, N. C.—Alexander Manufacturing Company is planning for the construction of a brick manufacturing building, and will install machinery to be operated by electric power drive.

MORGANTOWN, N. C.—Southern Power Company, Charlotte, is planning to construct a hydroelectric plant, which will require two dams on John's river.

REIDSVILLE, N. C.—The sum of $10,000 will be expended to construct an electric light plant. Address the mayor.

SUMTER, S. C.—The council will engage an engineer to prepare estimates for establishing a municipal electric light plant. Address the mayor.

NORTH CENTRAL STATES.

MASSILLON, OHIO.—The plant of the Massillon Electric Light Company was destroyed by fire recently.

CROWN POINT, IND.—Interstate Public Service Company will make extensions and improvements to the electric plant in Bedford, Corydon, Crown Point and other places. Address H. P. Broughton, local manager.

HUNTINGTON, IND.—Huntington Light & Fuel Company has filed a petition with the Indiana Public Service Commission asking permission to issue $200,000 of preferred stock to reimburse the treasury for money spent in improvements and to be spent on further improvements.

HUNTINGTON, IND.—United Telephone Company, which operates the service in the cities of Huntington, Bluffton and Marion, Ind., has asked permission from the Indiana Public Service Commission to issue notes for $350,000, due in two years, to retire bonds and to pay bills.

INDIANAPOLIS, IND.—Schroeder Headlight & Generator Company has increased its common capital stock from $150,000 to $200,000.

JEFFERSONVILLE, IND.—In resisting a petition of the Louisville and Southern Indiana Traction Company for an increase of city and interurban fares, Wilmer T. Fox, city attorney of Jeffersonville, has submitted a report showing that the new scale would mean a cash fare of 20 cents from a point in Jeffersonville to a point in New Albany or 17 cents by use of a commuter's ticket, whereas it now costs only 10 cents and the maximum increase distance is eight miles. He asks also in the answer that no increase of rates be granted, if at all, until the company provides adequate service.

PERU, IND.—The city of Peru, which owns and operates its municipal electric lighting and power plant, has asked the Indiana Public Service Commission for authority to increase domestic rates from 8 to 10 cents a kilowatt hour for the first 50 kilowatts and for an increase from 6 to 8 cents for all over 50 kilowatts. Increase in rates for power are also asked.

CHICAGO, ILL.—Central Illinois Public Service Company has filed a petition with the Illinois Public Utilities Commission to issue first and refunding mortgage gold bonds in the amount of $16,000.

EAST ST. LOUIS, ILL.—Southern Illinois Light & Power Company has asked authority from the Illinois Pub-

lic Utilities Commission to issue first mortgage six per cent gold bonds in the amount of $697,970 and cumulative preferred stock in the amount of $292,188.

IRVING, ILL.—Increased rates for electric service in Irving have been approved as filed with the Illinois Public Utilities Commission by the Southern Illinois Light & Power Company.

MATTOON, ILL.—The Illinois Public Utilities Commission has authorized the Central Illinois Public Service Company to issue $75,000 of gold notes.

PEORIA, ILL.—Electrical contractors of this city have met with the city council committees relative to proposed ordinances affecting the wiring of buildings. The contractors object to the provision whereby a property owner can take out a license to wire his own property and then turn the work over to journeymen.

TAYLORVILLE, ILL.—Central Illinois Public Service Company has asked the Illinois Public Utilities Commission for a straight six-cent fare and for the elmination of coupon books in Taylorville.

CAMP DOUGLAS, WIS.—Orange Light & Power Company will increase its hydraulic head and extend its transmission line to the village of Hustler. Address A. M. Patterson, manager.

CROSBY, MINN.—The city has voted $75,000 in bonds for the installation of an electric light and power plant. Address the city clerk.

IONA, MINN.—The council is considering means by which electric light may be secured. Address village clerk.

STILLWATER, MINN.—Twin City Forge & Foundry Company is installing docks at its plant in Stillwater to enable shipments of their finished products by barge. The power requirements of this concern will be supplied by the Northern States Power Company, Stillwater division, and work on the transmission line to serve the business will soon be completed.

LANESBORO, IOWA.—Election to vote $7000 bonds for electrical improvements carried recently.

PLATTSBURG, MO.—The special meeting of stockholders of Clinton County Telephone Company to vote on question of issuing bonds to pay the present indebtedness and make improvements in the service will be held shortly.

PLEASANT HILL, MO. — Green Light & Power Company is said to have acquired the electric lighting plant at Garden City, and is considering plans for the construction of a transmission system from Pleasant Hill to Garden City.

EDGERTON, KANS. — The town wants electricity. It is thought that the current will be procured by taking it from the Wellsville-Gardner transmission line.

GARFIELD, KANS.—Garfield Light & Power Company has chartered with $20,000 capital stock by H. J. Marquerdt, Wm. Portecus, A. T. Olson.

STOCKTON, KANS.—United Telephone Company has bought the Webster Central and twenty more lines are to be run from Stockton, the Webster lines being attached to this point.

TOPEKA, KANS. — Southwestern Bell Telephone Company has filed a petition with the Kansas Public Utilities Commission for an increase in toll rates throughout the state. It is estimated that the increases, if approved by the Commission, will amount to $99,568 from the large centers in Kansas alone.

FIRTH, NEB.—Bids will be received for extending the electric light system. Address J. S. Kallemyn.

SCHUYLER, NEB.—Plans are being prepared for improving the electric light system. Address city clerk.

MINOT, N. D.—The city's new well, which will be operated electrically with current furnished by the Northern States Power Company, Minot division, has been completed. The power installation will consist of a 150-horsepower, 3-phase, 2200-volt motor.

SOUTH CENTRAL STATES.

IRVINE, KY.—Irvine Electric Light Company was recently incorporated with a capital of $80,000 by John J. Langan and others.

NASHVILLE, TENN.—M. R. Stern and associates are completing plans for the organization of a new company to be capitalized at $200,000, to provide for the construction of a 10,000-horsepower electric generating plant near Columbia, Tenn.

ALEXANDER CITY, ALA.—The city has authorized a bond issue for $10,000 to provide for improvements in the electric lighting plant.

CRYSTAL SPRINGS, MISS.—Municipal bonds to the amount of $5000 will be issued for installing new equipment in the electric light plant. Address the mayor.

PURVIS, MISS.—Bids will be asked for the municipal electric system. Address mayor.

NEW ORLEANS, LA.—Construction of an electric interurban railway between New Orleans and Mobile is under consideration. Address J. D. Moore, city attorney.

HARTSHORNE, OKLA.—Choctaw Railway & Lighting Company will construct an electric system. Address general manager.

PERRY, OKLA.—Improvements are to be made to the light and water system. Address mayor.

STILLWATER, OKLA.—The city has had plans prepared for improvements and alterations in its electric lighting system to cost about $30,000. H. A. Pressey, Oklahoma City, is engineer.

DALLAS, TEX.—The city commission has given the Dallas Light & Power Company permission to begin improvements, estimated to cost over $350,000. The specifications include the extension of the car lines on Columbia avenue, a new feed line from the Oak Cliff line and other improvements.

FORT STOCKTON, TEX.—Pecos & Rio Grande Telephone Company is considering plans for the extension of its telephone system into Loon Valley.

LUBBOCK, TEX.—Election will be held April 5 to vote $25,000 bonds for purpose of buying, extending and improving the electric light and power.

WESTERN STATES.

PUEBLO, COLO. — The Arkansas Valley Railway, Light & Power Company has just completed an extension to the Outland Ranch where electricity (50 horsepower) will be used for lighting and power purposes. The Arkansas Valley Company has accepted a contract to extend its lines to other ranches in this vicinity.

DEMING, N. MEX.—Extensions and improvements involving the expenditure of $300,000 will be made at Camp Cody, Deming. The proposed work will include a 185-horsepower electric power plant.

PORTLAND, ORE.—Northwestern Electric Company will erect a steam auxiliary power plant to cost $1,500,000. The increasing demand for power by shipbuilding and other industries in the Portland district has necessitated the building of the new power plant. Address the general manager.

LOS ANGELES, CAL.—Wilbur O. Lusk of this city will develop electrical energy at a drop near Round Mountain. There will be a ditch and pipe line 6½ miles long and it is proposed to develop about 7500 kilowatts.

LOS ANGELES, CAL.—Plans and specifications for competitive bids for the ornamental lighting of more than 50 miles of Los Angeles streets were approved by the board of public works, and were forwarded to the council for the passage of the ordinances.

LOS ANGELES, CAL.—Contracts for additional lights in the Graham Lighting District were recently awarded to the Southern California Electric Company.

RICHMOND, CAL.—Western States Gas & Electric Company has accepted a contract with the Western Pipe & Steel Company for 65 horsepower in motors.

SAN FRANCISCO, CAL.—Colusa Land & Water Company will develop electric power for agricultural purposes. The work will consist of a main canal, 8.7 miles long, a pumping plant, consisting of one 42-inch pump with a capacity of 100 second feet, driven by a 400-horsepower motor, and two 26-inch pumps with a capacity of 50 second feet each, driven by a 200-horsepower plant. The estimated cost of the project is $219,890.

PROPOSALS

WIRE AND SEWING MACHINES.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for 205,000 feet lighting and power wire, rubber-insulated of 600 volts and less for delivery at the navy yard at Puget Sound, Wash., (Schedule 1774), and 124 electrically-driven sewing machines, 110 and 120-volt, for delivery at various navy yards (Schedule 1771).

CONVERTERS AND SWITCHBOARD.—Bids will be received until April 22 by the Bureau of Yards and Docks, Navy Department. Washington, D. C., for two rotary converters and switchboard for navy yard at Mare Island. (Refer to specifications 2872.)

Trade Activities

Hickey & Schneider Incorporate—Bryant Electric Personnel—Bay City Battery Service Company Formed—Catalogs

New England Westinghouse Company, Chicopee Falls, Mass., recently started assembling the first of the Browning machine guns made from tools. The Westinghouse Electric & Manufacturing Company through its subsidiary, the New England Westinghouse Company, will manufacture the bulk of the heavy Browning guns required by the government.

Cutting & Washington, Cambridge, Mass., representing manufacturers of radio and wireless apparatus, have installed at the plant of A. H. Cox & Company, 307 First avenue South, Seattle, Wash., a demonstration plant. A peculiarity of the set is the absence of buzzing in the receivers and the elimination of dangerous high-voltage current on the secondary side, it being possible to handle any part of the apparatus while in operation.

Hickey & Schneider, 141 Broadway, New York City, which in the past operated as a partnership for the manufacture of transmission-line equipment, has been reorganized by John Schneider and will continue as a corporation. The company will handle the sales and service work as one of the departments rather than through separate assistance as in the past. P. Kovac will act as new sales manager and will take charge of the sales and service department, located in the New York office. Mr. Kovac has had a broad experience in this line of business and has acquired intimate knowledge of the requirements of the public utility companies. The design work of this concern will be handled by P. S. Hauton, an engineer of broad European and American experience, particularly in high-tension design.

V. V. Fittings Company, with main offices at Philadelphia, Pa., and branches in New York and Chicago, is distributing a well illustrated bulletin, dealing with standardized "V. V." vapor-proof marine fittings, especially adaptable to the shipbuilding industry. Since the question of deliveries has become such an essential factor in the nation's shipbuilding program, odd sizes, special models and fancy specialties have been eliminated by the V. V. Fittings Company, not only to assure prompt deliveries but to patriotically serve the shipbuilding movement and aid in the establishment of efficiency and conservation. These fittings consist of four standardized parts, namely—fitting, cap, globe and guard. They are furnished in baked black enamel, a finish which has withstood severe tests and has been found to give very satisfactory results. "V. V." fittings are made for lamps to 60-watt size and for lamps 100-watt size, and are furnished with clear steam-tight globes. The company also announces the recent publication of bulletin No. 20-A, covering the complete listing of all "V. V." weather-proof fittings and safety devices.

Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has just issued a six-page folder, illustrating and describing C-H sectional battery charging equipment for industrial electric trucks. This type of battery charging equipment has been extensively used in both public and private garages for charging the batteries of pleasure and commercial vehicles, according to the company. During the past two years it has been widely adapted for charging industrial trucks, tractors, battery locomotives, battery driven chairs and starting and lighting batteries. This charging equipment is built on the sectional bookcase plan. Each section is a complete charging unit and new sections can be added with the purchase of additional trucks. A standard panel holds from one to six sections. This pamphlet points out such features of these rheostats as the rugged grid type resistance used; the elimination of all knife switches, and the use of heavy levers and handles on the instrument and low current cutout switches to withstand the rough usage in service. This equipment is complete and no additions or accessories need be added. Two pages are devoted to illustrating a number of large and small equipments in industrial establishments, piers and railroad terminals.

Bay City Battery Service Company, Bay City, Mich., was recently organized by James F. Bailey and D. R. Griffiths, who was engaged in the battery business at Detroit for almost 15 years. The firm handles Prestolite batteries, acetylene gas tanks, torches and accessories, and is prepared to handle all kinds of battery repair work, recharging, rebuilding, etc. A complete stock of new batteries, service batteries and repair parts is carried by the company.

Ivanhoe-Regent Works of the General Electric Company, Cleveland, Ohio, has issued catalog No. 257, dealing with Regent glass bowls, globes and reflectors for commercial and ornamental illumination. This catalog gives full data and illustrations of Sudan, Druid, Veluria reflectors, Regent shades and inclosing globes. Aside from the regular catalog data, much useful information is given in the way of engineering data for semi-indirect illumination of school rooms, drafting rooms and offices. Illustrations of typical installations in such rooms are also given.

Ross Power Equipment Company, Indianapolis, Ind., reports among its recent sales complete power plant equipment, consisting of a 500-kilowatt Westinghouse-Lentz high duty engine set, complete with switchboard, high pressure boilers, superheaters and other auxiliaries. The Detroit Shipbuilding Company, Detroit, Mich., has also purchased two 200-kilowatt, 250-volt, direct current steam turbo units, complete with condenser, switchboard and auxiliaries. The company also furnished equipment for the St. Paul Stone Quarries Company, St. Paul, Ind., with a number of smaller power plant installations. O. C. Ross, for many years connected with the Allis-Chalmers Manufacturing Company, is president of the company.

General Electric Company, Schenectady, N. Y., has recently completed a large reinforced concrete addition to the plant of the Sprague Electric Works at Bloomfield, N. J., which will provide increased capacity for the manufacture of generators, motors and controllers, dynamometers, hoists, ozonators and electric fans. To provide abundant light for manufacturing purposes and to eliminate dark corners, about 60 per cent of the wall area is devoted to window space, in addition to which the ceilings are painted with mill white flat finish to reflect the light to the best possible advantage. A steam vacuum heating system is installed and an abundance of coils are placed under the window so as to take care of the tremendous heat losses from a building having such a large surface of glass. In spite of the fireproofness of the building, automatic sprinklers have been installed throughout so that goods in storage or in process of manufacture can not be destroyed by fire.

Changes in Personnel of Bryant Electric Company.—The Bryant Electric Company of Bridgeport, Conn., has announced the personnel of its sales department. The position of general sales manager is established and to this is appointed Frank V. Burton who has been connected with the company for 16 years and has occupied the position of eastern sales manager for the last 11 years. William A. Stacey, who has been a field representative of the company in the middle west for the past 10 years, becomes western manager, succeeding to the position made vacant by the death of Edward K. Patton. John R. Topping, who has been connected with the Chicago office for more than 20 years, during most of which time he has been assistant manager, continues in that position. Harold E. Sanderson, for the past eight years manager of the office at San Francisco, continues in that capacity, but this office will in the future report direct to the general sales manager instead of being a subsidiary of Chicago. Robert M. Eames has been appointed export manager, with headquarters at Bridgeport. He has been connected with the company for 12 years, and for more than a year past has been devoting most of his attention to this growing department of the company's business.

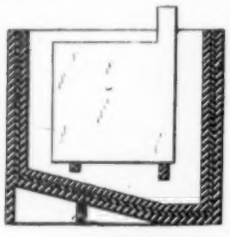
Recent Patents

Selected and Summarized by Albert Scheible, Patent Attorney, 79 West Monroe Street, Chicago, Illinois

A series of brief comments on some of the recently issued electrical patents which appear to be of particular interest to our readers, the number after each heading being that of the United States patent to which the summary relates. Any correspondence regarding such patent matters should be sent direct to Mr. Scheible at the above address.

Locating Faults on Alternating-Current Circuits (1,255,583).—When a fault occurs in a network of alternating-current conductors, a source of varying current is applied to the network. An inductance is so connected to the network as to be included in the probable path of the fault, thereby causing a change in the wave form of the fault current. Then the network is explored by means of an exploring coil and detector set. This method has been patented by Karl H. Bausman, of Dayton, Ohio.

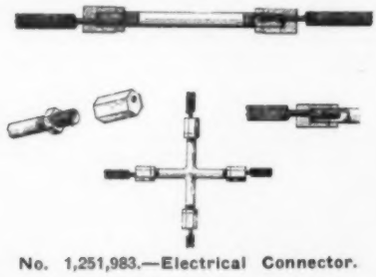
Storage-Battery Jar (1,260,071).—The inner jar of the battery, as arranged by Earl T. Schmucker, of Rapid City, S. D., has a sloping bottom and has supports for the battery plates. The outer jar closely fits it, but has a leg supporting the raised end of the bottom.



No. 1,260,071.—Storage-Battery Jar.

Motor Controller (1,260,215).—The controller of this patent (which was assigned by Wilmar F. Lent, of Philadelphia, to the Cutler-Hammer Mfg. Co., of Milwaukee) progressively connects a number of resistances in parallel and short-circuits them, so as to afford the desired acceleration in the speed of the motor, and later includes a limited portion of one of the resistances in the circuit again for use in regulating the speed of the motor.

Electrical Connector (1,251,983).—For a connector which will permit a speedy coupling and uncoupling of the connected wires, James H. Lockwood, of Bridgeport, Conn., inserts the tip of each wire through a bore in the end of a cap and into a bore in a connector part on which the cap is threaded. These bores are out of line with the axis of the cap, so that the wire is kinked by turning the cap.



No. 1,251,983.—Electrical Connector.

Electric Clock (1,255,905).—Instead of employing an oscillating armature for propelling an electric clock, Edwin H. Messiter, of Brooklyn, N. Y., uses a rotary motor arranged so as to impart a succession of rotative impulses to the driving shaft of the clock, and uses the escapement of the clock for controlling the periodicity of these impulses.

Turbine-Driven Electric Generator (1,255,589).—Mercury vapor is used as a current-collecting brush in the homopolar generator patented by Arthur S. Dysart, of the United States Navy. The rotor is hyperbolical in cross-section and revolves in a casing from which the air has been exhausted to eliminate windage losses, but which always contains mercury vapor. The interior of this casing and all except the periphery of the armature disk (which is radially slotted to avoid eddy currents) are both coated with an insulating enamel to avoid short-circuiting.

Molded Insulation (1,259,472 and 1,259,473).—These two patents, both assigned by the noted chemist Leo H. Baekeland to the General Bakelite Co. of New York City, relate respectively to a molded composition and to a process of molding articles. The composition consists of an infusible phenolic condensation product in solid solution with an organic substance which imparts the capability of welding to this product, so that the entire mass can be welded into a compact and coherent solid by the action of heat and pressure.

Making Dry Batteries (1,259,485).—According to this patent to Thomas W. Byrne, of Boston, Mass., a vacuum is produced within the zinc container after the carbon element and the depolarizing mixture are in place, and the solution of electrolytic material is then introduced into the cell under pressure.

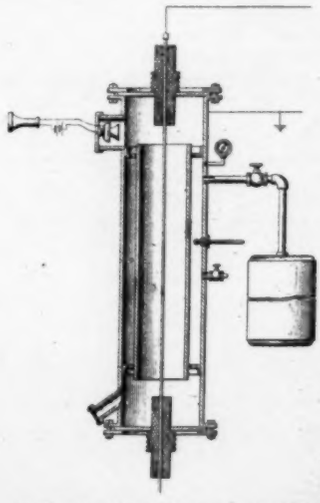
Prismatic Light Diffuser (1,259,493).—A funnel-shaped glass refractor with horizontally cut prisms is connected at its upper and larger end to the large end of a glass dome in which the prisms extend vertically. The patent, issued to William A. Dorey, of Newark, Ohio, was assigned to the Holophane Glass Co., of New York City.

Making Gas Electrolytically (1,259,898).—To produce oxygen and hydrogen from water, Felix A. Oswowski, of Detroit, Mich., acidulates the water and then feeds the water, drop by drop, across circuit terminals spaced so closely that each drop bridges across the gap. In this manner, he avoids the high resistance of the liquid as commonly treated in larger quantities, and decomposes each drop of water separately. He can also regulate the production of the gases by varying the rate at which the drops are fed.

Wire-Stripping Tool (1,260,642).—One end of a strip of steel is bent into a handle by which the strip may be pulled, and the other end is bent in the other direction and shaped to form a pair of stripper teeth. Patented by Bernard J. Chia, of East Orange, N. J.

No. 1,260,642.—Wire-Stripping Tool.

Measuring High Voltages (1,259,696).—This instrument, patented by Prof. John B. Whitehead, of Baltimore, Md., provides a conductor within a casing in which variations of air pressure or vacuum may be maintained. This pressure is then lowered until corona appears, as determined by means of a telephone receiver, and the indicated voltage can then be determined from the pressure and temperature within the casing, the diameter of the wire conductor, and the inside diameter of the casing.



No. 1,259,696.—Measuring High Voltage.

Men in Service

Phillip B. Woodworth to Serve in Signal Corps—C. R. Ammerman Commissioned—General Electric Welfare Work

JAMES W. PARKER, formerly connected with the Detroit Edison Company, Detroit, Mich., has taken up work with the Ordnance Department at Washington.

DALE LYLE, who has been in the office of the Sangamo Electric Company, Springfield, Ill., has resigned and has gone to Jefferson Barracks, St. Louis, Mo., to enter military service.

GEORGE A. FERGUSON, auditor of the Western States Gas & Electric Company, Richmond, Cal., division has entered government service under the draft, making six stars in the Richmond division's service flag.

CHARLES W. OSWALD recently tendered his resignation as director of the Cleveland Advertising Club, Cleveland, Ohio, to enlist in the Tank Corps of the National Army, now stationed at Gettysburg.

THOMAS N. MCCARTER, JR., son of Thomas N. McCarter, president of the Public Service Corporation, Newark, N. J., has given up his studies at Princeton University and enlisted in the infantry of the United States Army. Mr. McCarter, Jr., is only 18 years of age.

JULIUS ANDRAE & SONS COMPANY, Milwaukee, Wis., now carries on its roll of honor the following names of employees serving with the colors: Carl J. Andrae, P. T. Bowler, Harold Cole, J. F. DeBoth, John P. Ellenbecker, Russell D. Gray, Edward Hart, S. W. Holmes, Charles Lafferty, Anton Landergoth, A. McDaniels, Fred Moerchen, George Moore, L. Ray Mullinaux, John Overle, Carl R. Quast, Albert Quast, Roman J. Reichard, Fred Ruepart, F. J. Schmidt, William Simpson, C. R. Slensby, Joseph Sporer, Marian Wachowiak and Herbert Wechwerth.

PHILLIP B. WOODWORTH, professor of physics and electrical engineering at Lewis Institute, Chicago, has been appointed major in the aviation section of the Signal Corps. Major Woodworth has been in charge of the electrical and physics work at Lewis Institute since this school was founded, and has been dean of the evening schools at the institute for a great many years. He is also associated with the firm of Rummler & Rummler, patent attorneys, and has acted as technical expert in a large number of patent cases. He has been prominently identified with the American Institute of Electrical Engineers, the Western Society of Engineers and other engineering organizations. He was one of the active members of the old Chicago Electrical Association, which later grew into the electrical section of the Western Society of Engineers. For the last year or so Major Woodworth has specialized on internal combustion engines for aviation work, and it is to give his expert knowledge on the subject to the government that he has now been actively commissioned in the Signal Corps.

ROLL OF HONOR.

The electrical industry, perhaps to a greater extent than any other industry, has answered the call of the Nation for Men. As this is a war of engineers, naturally the technically trained men in the electrical industry have been in great demand and they have responded with splendid patriotism. Many of the large utility and industrial corporations have assigned men for Government service aside from those who have voluntarily entered or been called for service.

THE ELECTRICAL REVIEW will welcome news concerning men who have entered the service or who are engaged in any patriotic duties.

SECOND LIEUT. C. P. TAYLOR, formerly connected with the Pacific Gas & Electric Company, San Francisco, Cal., is at present on duty in the General Engineer Depot in Washington.

HENRY A. MACNAMARA, formerly manager of the Pacific Telephone & Telegraph Company, Hollister, Wash., was recently detached from an infantry regiment at Camp Lewis and sent to Washington for service in the signal branch of the army.

F. EMERSON HOAR, who for the past five years has been at the head of the gas and electric department of the California Railroad Commission, is now at Petersburg, Va., for training as a captain in the Engineers' Corps.

MAJOR GARRISON BABCOCK, Second Depot Battalion, Signal Corps, is expected to sail with his battalion in the very near future. Major Babcock was formerly a consulting engineer in Chicago and was president of the American Association of Engineers in 1917.

F. E. PERNOT, assistant professor of electrical engineering at the University of California, has been granted a leave of absence from the university in order to assist the government at Washington in certain radio work for the aviation service.

SAN DIEGO CONSOLIDATED GAS & ELECTRIC COMPANY, San Diego, Cal., has added the following names to its roll of honor, making a total of 75 employees now in the service of our country: Paul T. Emery, H. A. Lawton, J. G. Brown and David H. Moore.

F. A. C. TOCQUE, formerly news business manager of the Fort Smith Light & Traction Company, Fort Smith, Ark., has passed the necessary examinations for entrance into the Canadian Officers' Training Camp and will shortly sail for England. He expects to receive a commission in the Royal Engineers.

H. C. CUMMINS, assistant to the president of H. M. Byllesby & Company, Chicago, has joined the Ground Aviation Department as a private and will be stationed at Camp Dick, Dallas, Texas.

HAROLD GORE, formerly of the engineering department of H. M. Byllesby & Company, Chicago, and now a sergeant in the Signal Corps, recently passed an examination for service abroad and is now in France. He stood among the highest out of 5,000 examined and was one of the few selected to go abroad.

CHARLES R. AMMERMAN, a member of the engineering firm of Ammerman & McColl, Detroit, Mich., has received a commission as captain in the construction division of the Quartermaster's Reserve Corps, and has been assigned to duty at Camp Custer, where he has been making a survey of the heating plant for the last four weeks on request of the government. Captain Ammerman's wide experience in heating and ventilating engineering makes him a valuable official for the government work, as his firm has for some time been engineers for both the Detroit and Flint school boards.

WESTERN ELECTRIC COMPANY has added the following names to its roll of honor since the publication of the March issue of the News: Atlanta, C. H. Collier, E. C. Whitehead, A. Twilley; Cincinnati, E. C. Shlotman, R. A. Radley; Dallas, E. A. Abbott; San Francisco, G. F. Ballaseux, L. P. Bernett, R. S. Floyer, W. T. Lacey, L. Marechal, E. R. Murray; Seattle, E. Christian, C. F. Morris, R. E. Curran, Edwards Zeitz; general manufacturing department of Hawthorne, E. O. Alfsen, J. F. Broderick, L. R. Byrne, F. G. Dedic, J. E. Dolan, H. Evenhouse, J. D. Murphy, R. L. Richards, J. C. Snell, R. D. Tansey, E. Thorson and D. J. Swierczyncki.

GENERAL ELECTRIC COMPANY in the Chicago district has perfected an organization for the welfare of its men who have gone into government service. The organization was started early last fall by the appointment of a committee, consisting of a chairman, secretary-treasurer and members who are heads of departments. A "Service News Letter," which contains news of the company in this territory, interesting items from the press and extracts from letters received from soldiers, is being sent to all men in service twice a month. The stationery has an appropriate heading, stating that the letter is "issued occasionally" for the entertainment of Chicago district employes of the company now in service. The funds for this work are obtained by monthly contributions pledged by employes of the district, which represent 65 per cent of the entire force in the territory. The company has 75 men in various departments of military service, which number is being increased almost daily.

Personal

E. Cox Resigns—T. F. Murphine Becomes Public Utility Superintendent—A. M. Grall Joins Ashland Gas & Electric

J. HARRY SROUFE, of the Jaggar-Sroufe Company, Portland, Ore., was recently elected president of the Portland Association of Electrical Contractors and Dealers.

OTTO R. MALLAT, formerly secretary of the Lincoln Gas & Electric Light Company, Lincoln, Neb., has accepted a similar position with the Trumbull Public Service Company at Warren, Ohio.

JOHN L. RADENBAUGH, formerly in the installation department of the Pacific Telephone & Telegraph Company, Seattle, Wash., has been appointed manager and wire chief at Heppner, Oregon.

F. E. MCKENNA, formerly superintendent of the Oregon Power Company at Coquille, has been transferred to Marshfield as general superintendent for the Coos Bay division of the Oregon Power Company.

A. L. MARTIN, manager of the Oregon Power Company, Marshfield division, has been elected a member of the board of directors of the Marshfield Chamber of Commerce for the ensuing year.

F. BEASLEY, for many years connected with the Richmond (Ind.) Light, Heat & Power Company, has succeeded J. W. Brown as secretary of the Union Gas & Electric Company, Bloomington, Ill., the latter having engaged in other work.

A. W. LINCOLN, Philadelphia, Pa., has been appointed publicity manager for the Bell Telephone Company of Pennsylvania, succeeding John E. Boisseau, who resigned to become the vice-president of the National Union Bank of Maryland, Baltimore, Md.

J. F. MCGUIRE, manager of the Minot division of the Northern States Power Company, has been appointed chairman of a committee appointed by the Association of Commerce Board of Directors to ascertain whether it will be possible to secure cheaper gasoline and kerosene during the seeding season.

G. E. SWETT, sales agent General Electric Company, Seattle, Wash., has resigned to enter the employ of the Pacific Machine Shop & Manufacturing Company, Seattle, where he will assist in handling the complete line of auxiliary electrical equipment for use in ships manufactured by that company.

C. M. BREWER, manager of the Richmond, Cal., division of the Western States Gas & Electric Company, has been appointed a member of a committee organized for the purpose of assisting the Industrial Commission in effecting a suitable building and loan plan to increase the residences in Richmond. Mr. Brewer has also been made a member of the executive board of a newly organized war body to be called "Community Council for War Work."

O. J. RUNDAHL, chief engineer of the Canon City plant of the Arkansas Valley Railway, Light & Power Company, has been made a Canon City alderman to serve an unexpired term.

FRANK JOSE of the New York office of H. M. Byllesby & Company has been appointed assistant to the vice-president of the Metropolitan Canvass Committee of the Third Liberty Loan.

C. G. HYDE, professor of civil engineering at the University of California, is prominent on the list of those of the faculty doing war work, as the designer of 15 miles of sewer system for Camp Fremont.

W. L. MILLER, manager of the Interstate Light & Power Company at Galena, Ill., has been appointed secretary for the Third Liberty Loan drive in Jo Daviess county and manager of the publicity campaign.

W. H. BROWN, manager of the Red River Power Company, Grand Forks, N. D., has been appointed a member of the Liberty Loan Committee which will have charge of the present campaign in the Grand Forks district.

ALBERT M. GRALL, formerly representative of the new business department of the Empire District Electric Company, Webb City, Mo., was recently appointed new business manager of the Ashland Gas & Electric Company, Ashland, Ohio.

S. M. MCORE, for the last six years on the staff of the New Haven (Conn.) office of the General Electric Company, was recently appointed service manager of the power equipment department of the New England Engineering Company, Waterbury, Conn.

CHARLES E. COX, for the past 15 years with the Urbana & Champaign Railway, Gas and Electric Company, Champaign, Ill., has resigned to devote his entire attention to the automobile tire business in which he has already been interested for a number of months. Mr. Cox has served as cashier and as office manager for the utility company. He will be located in his new work in Champaign, Ill.

ALEXANDER GRAHAM BELL, inventor of the telephone, was the special guest at the dedication of the Alexander Graham Bell School in Chicago on April 11. This is a new school on the North Side of the city and is one of the largest in the public school system. It was named after Dr. Bell because of his great interest in the education of the deaf; the school has a large section devoted to deaf pupils. Dr. Bell took deep interest in the methods used in teaching this particular department. In the dedication exercises he spoke both in the afternoon and evening and told of his work in the teaching of the deaf, in which he was interested before the invention of the telephone. Dr. Bell was given a great ovation by the pupils.

EDWARD WHALEY, formerly secretary and general agent of the Northern California Power Company, San Francisco, Cal., was recently appointed general manager of the company.

Obituary.

GEORGE J. JACKSON, president of the National Conduit & Cable Company, died at his home in New York City, on April 8, at the age of 56 years. Mr. Jackson was prominently identified with the cable industry for 22 years, and prior to that time was engaged in the wholesale dry goods business as an importer. His first connection with the wire industry was with the Norwich Wire Company, which was later taken over by the National Conduit & Cable Company. At the time of the formation of that company, he was appointed its secretary. He later became chairman of its board of directors and was recently elected its president. Funeral services were held in New York and were largely attended by prominent electrical men and other friends.

RUFUS FRANKLIN EMERY, aged 48, secretary and treasurer of the Westinghouse Airbrake Company, Wilmerding, Pa., an officer and director of several other important corporations, died suddenly on April 11, having been stricken with heart disease while seated at his desk in the office of the company. Mr. Emery was born near Boston and came to the Pittsburgh district in 1891, when he became affiliated with the Westinghouse interests, in whose upbuilding he played an important part. He was a public spirited citizen and took an active interest in various religious, social, civic and patriotic movements, having been especially active in promoting the sale of the Third Liberty Loan bonds. The deceased leaves his widow, Mrs. Alice Jones Emery, a daughter, Miss Margaret Emery, and a son, Rufus Emery.

CHARLES F. SISE, chairman of the Bell Telephone Company of Canada, and founder of the telephone in that dominion, passed away at his home in Montreal on April 9, at the age of 81 years. Mr. Sise was born at Portsmouth, N. H., in 1834. As a young man he followed the sea and commanded one of his father's sailing vessels. He later took over his father's shipping and cotton business at New Orleans, and when the civil war broke out served as an officer. In 1879 he moved to Montreal, Canada, and in that year organized the Bell Telephone of Canada. He later organized the Northern Electric & Manufacturing Company, the Wire & Cable Company, and became interested in many other growing industries. A son, Charles F. Sise, Jr., is carrying on his father's work with the telephone company, and another son, Paul F., is managing director of the Northern Electric & Manufacturing Company of Montreal.

Financial News

Public Utility Commissions Change Views.

The new attitude of public utility commissions is reflected in the statement of Max Thalen, president of the California Railroad Commission, who proposes that commissions seek out utilities which need greater revenue and initiate proceedings to provide it. He says:

"Our public utilities must be kept in a sound and healthy financial condition, so that they will be able to meet not merely the requirements of their existing patrons, but also the additional requirements of the war.

"The state commissions should not wait until the utilities come to them their duty to inform themselves by their own investigations, if necessary, concerning the condition of the public utilities under their jurisdiction and to keep themselves constantly informed.

"If the state commissions rise to meet the situation, as they are doing in all sections of the country, they will be rendering a substantial service not merely to the utilities and their patrons but also to the nation itself, which is largely dependent for war efficiency on the service of public utilities."

Labor has become more lenient in its viewpoint of the utilities. The Union, one of the oldest labor publications in the country, under the heading of "How About Conserving the Public Utilities," says:

"Now this is obviously true. Either the public service commissions erred egregiously in estimating costs and fixing maximum rates when it made its schedules, under the old fixed charges for raw material and other costs of production, or the public utilities corporations are today carrying an unjust and impossible burden."

Copper Exports.

Reports of copper exports by months in gross tons, exclusive of shipments to Canada and Mexico:

	1918.	1917.	1916.	1915.
January	48,657	*51,322	23,663	26,193
February		*32,265	20,648	15,583
March		*51,218	26,321	30,148
April		*49,536	21,654	18,738
May		*49,245	16,062	28,889
June		*41,177	39,595	16,976
July		*24,363	35,066	17,708
August		*42,725	32,190	17,551
September		*29,509	29,803	14,877
October		*41,412	33,224	24,087
November		*39,044	22,598	23,168
December		*41,430	26,486	42,426
Total		493,356	327,310	276,344

*Exports to Canada included.

Liberty Bond Issues.

In support of the war program of the United States the Treasury Department, to March 12, 1918, has issued in Liberty Bonds, certificates of indebtedness, war saving certificates and thrift stamps a total to the value of $8,560,802,052.96:

First Liberty loan	$2,000,000,000.00
Second Liberty loan	3,808,766,150.00
Certificates of indebtedness:	
Total issue	$6,544,435,500.00
Total redeemed	3,888,698,000.00
Total outstanding	$2,655,737,500.00
War savings certificates and thrift stamps	96,298,402.96
Total	$8,560,802,052.96

Montana Power Bonds Offered.

Spokane & Eastern Trust Company, Spokane, Wash., is offering part of a 25-year 5 per cent bond issue of $4,000,000 of the Montana Power Company, which has been purchased by a New York syndicate. The bonds, maturing in July, 1943, are offered at 89 and interest. The Montana Power Company, associated with the Anaconda Copper Mining Company, is furnishing and extending the electrification of the Chicago, Milwaukee & St. Paul Railroad Company.

Pacific Power Financing Improvements.

The Pacific Power & Light Company, Portland, Ore., is raising a fund of $500,000 for capital requirements in meeting demands for more power in the territory. The loan will mature in 17 months, yielding an interest return of 7.7 per cent. The Lumbermen's Trust Company is a member of the syndicate which is offering these secured notes to investors.

American Telephone & Telegraph Lists New Stock.

The American Telephone & Telegraph Company has listed on the Boston stock exchange $6,000,000 additional capital stock. This brings the total amount of stock outstanding, together with the $425,100,000 not yet fully paid, to $442,185,800. This new stock was issued for the purpose of purchasing from the New York Telephone Company 75,000 shares of the capital stock of the Bell Telephone and Telegraph Company of Pennsylvania.

Westinghouse Government Orders.

At present Westinghouse Electric Company has on hand orders for nearly $150,000,000 of apparatus and war supplies. This bulk of business includes its large output of shells and the product of its New England Westinghouse Company, which is now making quantity production of heavy Browning machine guns. The $150,000,000 of orders is practically 18 months of capacity work. Westinghouse's fiscal year ended March 31. It is estimated that final figures will show net profits for the year of $70,813,000 common, equal to 20 to 25 per cent. The latter figure would equal the 1917 record.

Southern New York Power to Issue Bonds.

Southern New York Power & Railway Corporation has filed a petition with the Public Service Commission at Albany, asking for authority to execute a first mortgage to the Equitable Trust Company as trustee to secure an issue of $5,000,000 6 per cent 10-year bonds. The company asks that it be allowed to immediately issue $952,000 of these bonds in exchange for outstanding bonds and to issue $48,000, the proceeds of which are to be used for the purchase of an equal amount of bonds of the Deposit Electric Company. The remaining $4,000,000 of these bonds are to be issued from time to time for the acquisition of additional property and for extensions, additions, improvements and betterments to the company's property which be necessary.

Continental Gas & Electric Has Record Year.

In spite of the unparalleled conditions which prevailed, the year of 1917 was the most properous in the history of the Continental Gas & Electric Corporation. This corporation operates a chain of gas and electric properties in Iowa and Nebraska and has its headquarters in the Cuyahoga building, Cleveland, W. H. Abbott, the vice-president, being located at Omaha. President C. S. Eaton, of Cleveland, in his annual report gives the following comparative earnings of the corporation's subsidiary companies:

	1917.	1916.
Gross earnings	$1,302,704.15	$714,203.39
Operating expenses, including maintenance, taxes and insurance	930,697.24	473,751.03
Interest on outstanding bonds of subsidiary companies	32,910.00	5,790.00
Balance	339,096.91	234,662.36
Interest accrued during 12 months' period on Funded Debt of Continental Gas and Electric Corporation	118,835.87	88,630.00

Northern States Power Bonds.

Northern States Power Company has sold $1,000,000 first and refunding 5 per cent mortgage bonds, due April 1, 1941, to a syndicate composed of Guaranty Trust Co., Harris Trust and Savings Bank, H. M. Byllesby & Company, and Bonbright & Company. Issue has been approved by the Capital Issues Committee. Proceeds of the sale will be used to finance extension to the company's lines to serve new business. The company reports gross earnings of $7,133,257 for the year ended January 31, 1918. Net after taxes was $3,303,599 and surplus after charges, $1,797,374.

Earnings.

AMERICAN POWER & LIGHT COMPANY.

The operating companies now controlled by the American Power & Light Company, intercompany charges eliminated, reports for February as follows:

	1918.
Gross earnings	$ 1,109,709
Net earnings	462,635
For the 12 months ended February 28:	
Gross earnings	$11,656,266
Net earnings	4,846,470

KANSAS GAS & ELECTRIC COMPANY.

	1918.	1917.
February gross	$ 183,533	$ 186,021
Net after taxes	54,549	52,928
Surplus after charges	26,700	32,948
12 months' gross	1,775,137	1,631,220
Net after taxes	498,418	579,279
Surplus after charges	204,556	356,953

PACIFIC POWER & LIGHT COMPANY.

	1918.	1917.
February gross	$ 145,080	$ 123,669
Net after taxes	73,568	56,794
Surplus after charges	36,890	22,468
12 months' gross	1,691,184	1,486,852
Net after taxes	900,682	714,798
Surplus after charges	461,471	311,470

PORTLAND GAS & COKE COMPANY.

	1918.	1917.
February gross	$ 135,324	$ 105,315
Net after taxes	64,381	48,443
Surplus after charges	34,910	21,093
12 months' gross	1,415,151	1,266,797
Net after taxes	634,476	605,195
Surplus after charges	294,257	281,194

BRAZILIAN TRACTION, LIGHT & POWER, LTD.

Combined earnings of all subsidiaries, in milreis, compare as follows:

	1918.	1917.
February gross	7,515,000	6,872,000
Net earnings	3,565,000	3,885,000

NORTHERN OHIO TRACTION & LIGHT COMPANY.

	1918.	1917.
February gross	$ 526,542	$ 477,004
Net after taxes	170,358	179,796
Surplus after charges	78,076	97,116
Two months' gross	1,068,843	967,385
Net after taxes	341,801	387,334
Surplus after charges	154,854	220,646

PACIFIC POWER & LIGHT COMPANY.

	1918.	1917.
January gross	$ 153,062	$ 130,690
Net after taxes	81,279	61,054
Surplus after charges	45,081	27,328
12 months gross	1,669,773	1,473,152
Net after taxes	883,908	709,910
Surplus after charges	447,049	308,130

PHILADELPHIA ELECTRIC COMPANY.

Income account of the Philadelphia Electric Company of New Jersey for year ended December 31, 1917, compares as follows:

	1917.	1916.
Gross earnings	$12,160,768	$10,260,072
Net income	*2,018,194	2,794,051
Dividends	1,749,188	1,574,312
Surplus	$ 269,006	$ 1,219,739

*Equal to 8.07 per cent on $24,987,750 capital stock, compared with 11.2 per cent earned in 1916.

JACKSONVILLE TRACTION COMPANY.

	1918.	1917.
February gross .....$	66,004	$ 53,932
Net after taxes	18,759	16,619
Surplus after charges	1,729	1,127
12 months' gross ...	716,591	637,103
Net after taxes	228,210	207,664
Surplus after charges	37,459	22,168

HOUGHTON COUNTY ELECTRIC LIGHT COMPANY.

	1918.	1917.
February gross .....$	35,101	$ 38,101
Net after taxes	13,473	19,494
Surplus after charges	6,721	13,392
12 months' gross ...	417,499	399,422
Net after taxes	168,672	197,599
Surplus after charges	91,794	127,977

NEW ORLEANS RAILWAY & LIGHT COMPANY.

Consolidated income account of the New Orleans Railway & Light Company for year ended December 31, 1917, compares as follows:

	1917.	1916.
Total operating revenue .....$	7,746,259	$7,200,740
Net after expenses and taxes	2,763,121	2,821,756
Gross income	2,821,534	2,883,431
Balance after charges	655,477	724,705
Subsidiary company dividends*	4,251	4,352
N. O. R. & L. divs....	371,430	546,147
Surplus after dividends	279,796	174,206

*Dividends on stocks of subsidiaries held by others.

YAMHILL ELECTRIC COMPANY.

Yamhill Electric Company has filed with the public service commission its report covering the year 1917. The following figures are shown: Operating revenue, $40,587.35, an increase of $3575.96; operating expenses, $25,490.57, an increase of $1619.64; net operating revenue, $15,096.78; taxes, $2570, an increase of $555; uncollectable operating revenue, $19.20, a decrease of $27.87; operating income, $12,507.58, an increase of $1429.19. The offices of the company are at Newberg and it furnishes service to Newberg, Carlton, Dayton, Dundee, St. Paul, Lafayette and Springbrook.

Dividends.

Commonwealth Power, Railway & Light Company has declared a dividend of 1½ per cent in scrip on preferred stock, payable May 1 to stock of record April 12. The previous dividend on the preferred stock was payable in scrip, due on or before February 1, 1924, with interest at 6 per cent.

Fort Worth Power & Light Company has declared its regular quarterly dividend of 1¾ per cent on preferred stock, payable May 1 to stock of record April 20.

Keystone Telephone Company has declared the regular semi-annual dividend of 3 per cent on preferred stock, payable May 1 to stock of record April 20.

Havana Electric Railway, Light & Power Company has declared the regular semi-annual dividends of $3 per share on both the preferred and common stocks, payable May 15 to stock of record April 25.

Rio de Janeiro Tram, Light & Power Company has declared a quarterly dividend of 1¼ per cent, payable May 1 to stock of record April 15.

San Paulo Tram, Light & Power Company has declared a quarterly dividend of 2½ per cent, payable May 1 to stock of record April 15.

Manhattan Electrical Supply has declared a special dividend of 1 per cent on common stock, payable May 1 to stock of record April 20.

Electric Bond & Share Company has declared its regular quarterly dividend of 1¾ per cent on preferred stock, payable May 1 to stock of record April 17.

Edison Electric Illuminating Company of Boston has declared the regular quarterly dividend of 3 per cent, payable May 1 to stock of record April 15.

Public Service Investment Company has declared the regular quarterly dividend of $1.50 on preferred stock, payable May 1 to stock of record April 15.

BELL TELEPHONE SYSTEM.

Earnings report for the three months ending March 31, 1918. (All duplications including interest, dividends and other payments to American Telephone & Telegraph Company by associated companies are excluded.)

	Average first quarter 1913-1915.	Average first quarter 1916 and 1917.	First quarter 1918.*
Exchange revenues	$39,203,734	$48,056,180	$54,015,000
Toll revenues	13,746,943	17,911,557	21,505,000
Miscellaneous revenues	525,288	673,515	780,000
Total operating revenues	$53,469,965	$66,641,252	$76,300,000
Depreciation	$ 9,661,549	$12,327,142	$11,750,000
Current maintenance	7,441,836	8,451,504	10,640,000
Traffic expenses	10,131,359	13,802,113	20,080,000
Commercial expenses	5,689,256	6,544,796	7,620,000
General and miscellaneous expenses	2,548,670	2,897,261	3,600,000
Total operating expenses	$35,472,670	$44,022,816	$53,690,000
Net operating revenue	$17,997,295	$22,618,436	$22,610,000
Uncollectible revenues	391,927	372,062	330,000
Taxes	2,981,448	3,947,177	5,480,000
Operating income	$14,623,920	$18,299,197	$16,800,000
Net non-operating revenues	1,500,422	1,893,491	2,470,000
Total gross income	$16,124,342	$20,192,688	$19,270,000
Rent and miscellaneous deductions	$ 1,019,704	$ 922,769	$ 1,070,000
Interest deductions	4,472,154	5,021,045	5,435,000
Total deductions	$ 5,491,858	$ 5,943,814	$ 6,505,000
Balance net income	$10,632,484	$14,248,874	$12,765,000
Deduct dividends	7,675,842	8,801,203	9,830,000
Surplus earnings	$ 2,956,642	$ 5,447,671	$ 2,935,000
	Total March 31, 1915.	Total March 31, 1917.	Total March 31, 1918.*
Miles of wire (owned)	17,636,042	20,316,471	22,770,582
Bell stations (owned)	5,669,473	6,737,703	7,128,069
Bell connected stations	3,096,455	3,376,000	3,475,909
Total stations	8,765,928	10,113,703	10,603,978

*One month estimated.

WEEKLY COMPARISONS OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid Apr. 9.	Bid Apr. 16.
Adirondack Electric Power of Glens Falls, common	6	14	13
Adirondack Electric Power of Glens Falls, preferred	6	68½	68
American Gas & Electric of New York, common	10+extra	87	..
American Gas & Electric of New York, preferred	6	40	39
American Light & Traction of New York, common	..	199	189
American Light & Traction of New York, preferred	6	95½	93
American Power & Light of New York, common	4	40	40
American Power & Light of New York, preferred	6	73	70
American Public Utilities of Grand Rapids, common	..	20	20
American Public Utilities of Grand Rapids, preferred	6	50	50
American Telephone & Telegraph of New York	..	99½	100
American Water Works & Elec. of New York, common	..	4⅜	4¾
American Water Works & Elec. of New York, particip	7	12½	13
American Water Works & Elec. of New York, first preferred	..	58¼	57
Appalachian Power of Bluefield, common	..	2¼	2¼
Appalachian Power of Bluefield, preferred	7	20	20
Cities Service of New York, common	+extra	202	202
Cities Service of New York, preferred	6	75	74½
Commonwealth Edison of Chicago	8	105	104
Comm. Power, Railway & Light of Jackson, common	..	22½	22½
Comm. Power, Railway & Light of Jackson, preferred	6	47½	47½
Federal Light & Traction of New York, common	..	6	5½
Federal Light & Traction of New York, preferred	..	26	26
Illinois Northern Utilities of Dixon	6	..	..
Middle West Utilities of Chicago, common	2+extra	24½	25
Middle West Utilities of Chicago, preferred	6	56	58
Northern States Power of Chicago, common	ex.div.7	45	40
Northern States Power of Chicago, preferred	ex.div.7	84	84
Pacific Gas & Electric of San Francisco, common	..	33	35
Pacific Gas & Electric of San Francisco, preferred	6	79½	..
Public Service of Northern Illinois, Chicago, common	7	74	75
Public Service of Northern Illinois, Chicago, preferred	6	85	84
Republic Railway & Light of Youngstown, common	4	22½	22
Republic Railway & Light of Youngstown, preferred	6	57	56
Standard Gas & Electric of Chicago, common	..	4	4
Standard Gas & Electric of Chicago, preferred	6	23	24
Tennessee Railway, Light & Power of Chattanooga, common	..	2½	2¼
Tennessee Railway, Light & Power of Chattanooga, preferred	6	8	8
United Light & Railways of Grand Rapids, common	4	28	28
United Light & Railways of Grand Rapids, preferred	6	58	58½
Western Power of San Francisco, common	..	12½	13¼
Western Power of San Francisco, preferred	6	48	49
Western Union Telegraph of New York	extra	92½	94⅞
Industrials—			
Electric Storage of Philadelphia, common	4	48	48¼
General Electric of Schenectady	8	137½	136¼
National Carbon of Cleveland, preferred	8	56¾	56¼*
National Carbon of Cleveland, common	..	130⅜	130⅜*
Westinghouse Electric & Mfg. of Pittsburgh, common	+extra	40⅛	39⅛
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	59	55

*Last sale.